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Saint Mark's Square, Venice, showing the famous Campanile 323 feet in height. For comparison our artist has drawn upon the picture the Bankers' Trust Building which, upon a base 95 feet square, rises to a height of 540 feet.

CAMPANILES MEDIEVAL AND MODERN.—[See page 6.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Utility of Beauty

EVIDENCES are not wanting of a growing appreciation of the fact that in those broad fields of human activity which are covered by the architect and the engineer, there is no necessary antagonism between the useful and the beautiful. Too long the idea has prevailed that whenever we depart from those forms and dimensions which are demanded by a strict consideration of prospective returns on the money invested, a more or less serious money loss will be involved. Now, although there may be some truth in this conviction, it is not altogether true. For the public taste has been educated to a point where it is beginning to be recognized that in the construction of municipal works and of the more monumental of our commercial buildings, their value is distinctly increased, even as to their revenue-earning capacity, in proportion as they are invested with true beauty and dignity.

Even at this early day in the movement toward the realization of the city beautiful, there are several notable instances of the recognition of the principle above referred to; and we draw attention to the fact that when the architects of the office building which forms the subject of our front-page engraving urged upon the syndicate who are financing the structure the advisability of setting the front walls of the building well back from the columns of the loggia near the top of the building, and also proposed to run up the pyramidal roof in solid granite, free from windows, the committee, in spite of the fact that much very valuable rentable floor space would be lost, were willing to make the sacrifice for the sake of the gain in architectural effect. The concession was made on the understanding and recognition of the fact that the modern building which possesses architectural beauty and dignity is preferred by prospective tenants to those bald and cheerless monstrosities whose architects seem to have taken a perforated packing case as their model.

Other and even more notable instances are the two magnificent terminal buildings of the Pennsylvania and the New York Central railroad companies. The early plans for the station building of the New York Central showed a 25-story office building, towering above the station proper. Nevertheless, upon further consideration, the company decided to forego the large financial profits which could have been secured from a building of this character, in favor of the more beautiful and dignified structure which will form the easterly entrance gate to their great railroad system.

So, also, the Pennsylvania Railroad, in the same admirable spirit of regard for the architectural embellishment of New York city, chose to erect over their terminal a monumental classic structure barely seventy feet in height of façade, which is one of the most handsome buildings of its kind in the world. Here also, had the company chosen to do so, they could have derived a princely revenue by erecting a towering building upon the site, 400 by 700 feet square, occupied by this station.

Mention should also be made of that exquisite architectural structure which forms the home of the New York *Herald*. Too hasty considerations of utility might have prompted the erection on this valuable site of a typical skyscraper; but we venture to believe that the appreciation of the motives which led to the construction of this modest but beautiful building must have gone far to offset any pecuniary loss due to its limited size.

A New Danger for the Airman

THE two terrible accidents which occurred the opening day of the great circuit aeroplane race from Paris to London and return have opened the eyes of the aviation world to an ever-threatening danger to those who navigate the air in present-day aeroplanes. The monoplanes of two competitors caught fire in the air and fell like flaming meteors to the ground. The unfortunate airmen, strapped in behind their burning gasoline tanks, were frightfully burned before they were killed by the fall.

These catastrophes have brought out afresh, and very forcibly, the constant danger from fire in the flimsy structure of sticks and cloth that constitutes the modern aeroplane. In the first case of a machine catching fire in flight, which happened in Germany more than a year ago, we pointed out the necessity of fire-proofing the burnable parts of these machines, or of making them entirely of metal, so that they would not be consumed in case of fire. The late John B. Moisant claimed to have designed and built, in France, the first all-metal monoplane nearly two years ago, and of late a number of machines have been built there and in America largely of metal construction; but the great majority of aeroplanes in actual use are constructed of wood and cloth. Only a few days before the double disaster in France, above mentioned, a new biplane caught fire at Mineola while in flight, the whole center section being burned out before the machine came to earth and the flames were extinguished. There are several ways in which an aeroplane can catch fire from the gasoline motor that propels it. If the carbureter is located near and over the exhaust and a slight leak occurs, the dripping gasoline can easily ignite and set fire to the carbureter, thus creating a sufficient flare-up to ignite the cloth and woodwork. Hamilton's machine was partially burned in this way during preparations for a flight in the West. In a monoplane such as the Blériot, where the sides of the body at the front are formed of sheet aluminium, and where an inclined partition separates the aviator from the motor, there is a chance that the machine itself will not catch fire immediately and that the aviator may be able to shut off the gasoline and let what in the carbureter burn itself out. As the gasoline tank is placed back of the inclined partition, there is a fair chance that the flame will not reach it; but, on the other hand, the aviator may not be aware of the fire until the machine bursts in flames and it is too late to avert disaster. Such was evidently the case with Landron, in the De Pishoff monoplane.

There is another way in which the carbureter can ignite, and in all probability the accident happened in this way in Landron's case. A weak mixture or an air leak in the inlet pipe will sometimes cause a back-fire through this pipe to the carbureter, and there is an even chance that the gasoline in the carbureter will thus become ignited. Since the carbureter was hidden away beneath the engine hood, the aviator was probably unaware of the fire until the flames came back in his face. The aeroplane was flying at the height of nearly 2,000 feet when it caught fire. From the huge sheet of flame that shot forth, there is little doubt but that the gasoline tank ignited soon after the carbureter.

From the foregoing it would seem that in a monoplane the gasoline tank should be carried in the body, back of the aviator, the fuel being forced to the carbureter under pressure. This arrangement would be similar to that used on some automobiles, where the tank is at the rear end of the car. There should also be a shut-off that can be quickly turned by the aviator in case of emergency. In a biplane, instead of being placed above the lower plane just back of the aviator, the tank should be located beneath this plane, or should be suspended between the outriggers well to the rear. There have been several instances in which a machine, when it plunged to the ground, has caught fire owing to the proximity of the gasoline tank to the motor and the fact that the engine was still running. In the smashing of the R. E. P. monoplane, when it upset in making a turn in a wind of some 40 miles an hour, the body of the passenger, Lieut. Depuis, was charred beyond recognition owing to the debris catching fire instantly when the machine struck the ground.

It will be seen, from the various accidents here mentioned, that the danger of fire is an ever present one, and one that every precaution should be taken to abolish. Because of the wide experience had with the internal-combustion motor in automobiles, the action of a gasoline motor, and the accidents to which it is liable, are so well known as to render the loss of a single life from fire in the air quite inexcusable. Designers of aeroplanes should see to it in the future that there is no possible chance of their machines igniting while in flight.

Biology and Biography

PROBABLY no phenomenon within the range of natural science appeals to us with greater interest than that complex series of events and actions which we call life. For we ourselves are living beings, and those effects which we observe in other creatures in the dispassionate spirit of scientific inquiry, are known to us by direct experience also, and touch the innermost nature of our conscious being. Ordinarily, when we speak of human life, we mean that succession of mental experiences with which the biographer and the novelist are concerned —the "mind life" which begins anew with each individual—rather than the biological or "material life"—which is absolutely continuous from generation to generation. The "mind life" may seem to us so to transcend the mere biological phenomena accompanying it, that these in comparison appear insignificant. Yet it is well to remember that the two stand in the closest possible relation. It appears that there can be material life without consciousness, but so far as we know, there is no consciousness without material life. Unconscious states in life we know from our own normal experience of sleep, as well as from abnormal diseased conditions ranging from a passing swoon to a mortal coma. We know, too, that by reflex action we can perform, wholly or in part aside from conscious control, various motions of a useful character. It is possible that in low forms of organisms all actions are of this kind; there seems to be no warrant, for example, for supposing that the amœba is in any sense "conscious."

As has already been indicated, however, such consciousness as we know is not only invariably associated with material life, but its character, its "color," is inextricably bound up with the past and present conditions and physical experiences of the individual. Now these conditions may be said to depend on two classes of factors. On the one hand they are determined by the "external circumstances" under which the individual is placed; these vary from case to case in a somewhat haphazard manner. On the other hand the condition of the individual, as he wends his way through life, is determined also by the progressive biological changes which lead him from childhood through adolescence to maturity and old age. These changes proceed in a regular manner, following in all normal individuals a common law or order, and thus impressing a specific stamp upon human life, and ranging all individuals under one general type.

To each man in his turn, rich and poor alike, regardless of circumstances, are revealed the basic truths of life. The gain in wisdom, which comes with the years, is not a mere accumulation of knowledge acquired through the information carried to us from outside by our senses, but is rather a change in point of view, an evolution from within. The same event is seen in a different light by the young child, living in a world of naive innocence, by the adolescent, when the blood runs hot and energy abounds, and by the veteran, in whom the lamp of life burns low. This is the romance of life, sung by the poet and represented in our best fiction. For, just as perfection of physical form, the expression of biological haleness, appeals to our æsthetic sense and elicits our homage, so the contemplation of its spiritual counterpart, the "perfect life," in which all human faculties are developed to their highest excellence and perform their functions uncurtailed and untrammeled, speaks to us with its own inspiration. Such perfection is, however, but an artist's ideal, rarely approached in real life. Indeed, the other extreme is perhaps more common, the crippled in body, though undaunted in spirit, who would fain—but cannot—join others in their toil and play; and the crippled in life, who through untoward circumstances is deprived of the opportunity to exercise his faculties to the full; condemned to drag out a colorless existence to the end of his days.

Between these two extremes the average human life is laid. Through each runs a similar thread, as our biological make-up is similar. But the details differ from case to case. To each of us in turn life's story is told. We listen, as to some old melody, played with infinite variations, now in a major, now in a minor key—rehearsing ever the same theme, yet never twice the same; each listener hears the strain but once, and with its last note his span of life also expires.

Cross-Country Aeroplane Races in Europe

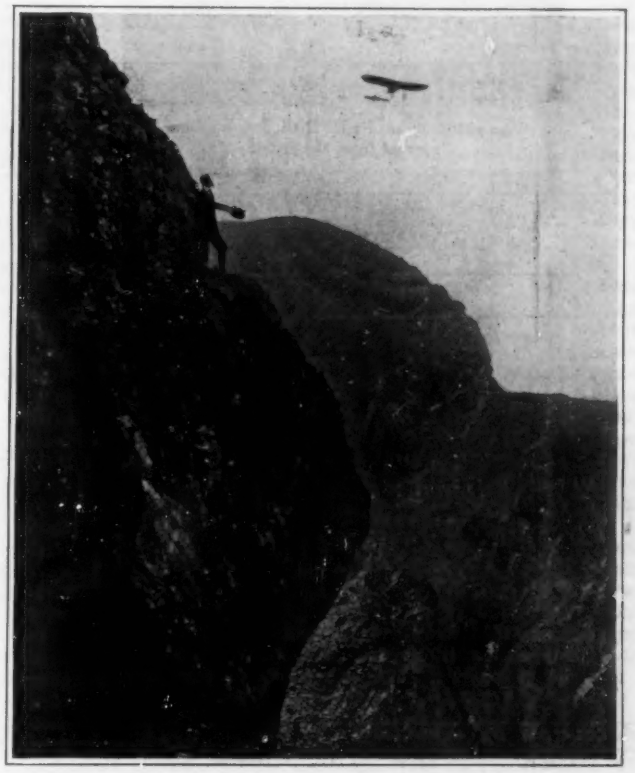
Further Particulars Regarding Recent Record-Breaking Flights

WHAT Vedrines had to fly over in his wonderful flight from Paris to Madrid is graphically shown in the photograph reproduced on this page, for which we are indebted to *The Car*. Flying low over the rugged peaks of the Pyrenees, Vedrines took chances such as only the most daring aviators would take.

Starting from San Sebastian at 7:20 A. M. on the morning of May 25th in a dense fog, Vedrines succeeded in crossing the Pyrenees and reaching Quentanna-Pella, a few miles from Burgos, where he was obliged to repair the damage to his tank and to get aid to place his machine on a suitable field for restarting. He then flew back to Burgos, where he passed the night and made a fresh start at 5:20 A. M. the next morning. He covered the remaining 135 miles to Madrid without a stop in 2 hours and 46 minutes, alighting on the aerodrome at 8:06 A. M. amid the applause of thousands of spectators. His total time in flight for the 722 miles was 14 hours and 54 minutes, so that he covered the distance from Paris to Madrid at an average speed of 48½ miles an hour. His total official time, including penalization, was 37 hours 27 minutes 12 1/5 seconds.

The other two survivors, Garros and Gibert, did not fare so well as Vedrines. The former got only 5 miles from San Sebastian when he was obliged to descend because of a motor mishap. He restarted and flew a few miles farther, when he came down at Andoain, where he broke his propeller and damaged his machine so that he was obliged to give up the race. Gibert, after crossing the Pyrenees, landed at Alsacua, near Vitoria, but in restarting his Blériot upset on account of the rough ground and was badly damaged. He made repairs, but was hindered from continuing the flight the next day on account of bad weather conditions.

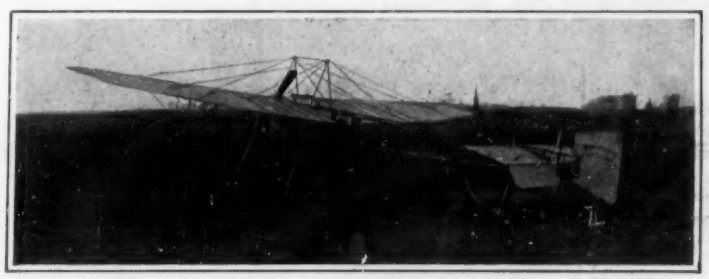
One of our illustrations shows Vedrines on his Morane monoplane just after he alighted at Madrid. The flatness of the wings is very noticeable in this photograph, there being so slight a curvature that it is almost imperceptible. It is due to the flat wings in combination with the 70 horse-power Gnome motor that Vedrines is able to obtain a speed in straightaway flight of about 75 miles an hour. The specifications of his machine appear in the table on the following page. The supporting surface of the wings is 17½ square meters and the spread 9½, while the total length of the machine is 7 meters. The loading is about 6.1 pounds per square foot. Scale drawings of this machine were published in SUPPLEMENT No. 1851. It is one of the most advanced types of monoplanes thus far produced, and probably the fastest with a given horse-power when traveling in a straight line. One noticeable point is the curving of the front edge of the wings at their outer end instead of the rear edge, as with the Blériot. In the Paris-Rome-Turin race Vedrines did not have good luck. He started several days after the others and only got as far as Macon, where his machine was demolished in alighting and he abandoned the race. Gaget and Frey both drove Morane monoplanes with 50-horse-power Gnome motors. The former, when starting at Laumes, ran into a dog and smashed his machine, which caused him to abandon the race; but Frey, after many mishaps and the substitution of a new machine, succeeded in reaching Rome third in 132 hours and 41 minutes. Lieut. Conneau, on his Blériot, was first in 82 hours and 5 minutes, and Garros second in 106 hours and 16 minutes. Frey was the only competitor who tried to continue to Turin. After making several starts and returning to the aerodrome, on account of bad weather, he at length came to grief in a storm and fell upon marshy land with great force, two arms and one leg being broken and the aviator being saved from instant death merely from the fact that he fell in a soft spot and that he wore a safety helmet. Vidart was the only other aviator in the race to reach Rome. He arrived on his Deperdussin monoplane several days after Conneau and Garros, his time for the trip being 171 hours and 13 minutes. The prizes won by the four men who finally arrived at Rome were as follows: Lieut. Conneau, $21,800; Garros, $9000; Frey, $4600; and Vidart, $4000.



Vedrines crossing the Pyrenees in his flight to Madrid.

Vedrines' Morane monoplane after its arrival at Madrid.

Note the almost perfectly flat wings used on this fast machine.



Three-quarter rear view of Sommer monoplane.

Tail of Sommer monoplane, showing flap elevators at rear.

FAST AEROPLANES IN THE EUROPEAN CIRCUIT RACES

One of the new monoplanes that appeared in the Paris-Rome race was the Sommer, photographs of which are reproduced herewith. The three Sommer monoplanes in the race were flown by Kimmerling, Bathiat, and Molla. Kimmerling was delayed at Brignoles for several days. He finally received a new machine and got as far as Cabase (Var), where the machine capsized and was badly damaged. Bathiat got as far as Lyons, where he was obliged to abandon the race. He covered the 68 miles from Dijon to Macon in 54 minutes, or at the rate of 75.9 miles an hour. The Sommer monoplanes seem to have met with bad luck and to have experienced considerable motor trouble. One of their pilots took along carrier pigeons with which to send back messages when he experienced breakdowns. Molla flew as far as Vienne, which was the greatest distance traversed by any of these machines. Bathiat's record between Dijon and Macon shows the Sommer monoplane to be a fast machine.

The first great circuit race, and the longest and most popular of all the big cross-country flights scheduled in Europe this summer, is that known as the European circuit, which starts from Vincennes on June 18th and includes a double crossing of the Channel with a turning point at London. Nearly $100,000 in prizes were put up, including $12,500 by the London *Standard* for the first machine to arrive at London. There were some sixty-five entries in all, but about fifteen of these canceled, and when it came to the start of the race thirty-nine machines crossed the line. The first stage consisted of a flight of 212 miles to Liege, with an obligatory stop at Rheims on the way; the second stage was a round trip to Spa and return, a total distance of 37¼ miles; the third stage brought the flyers to Utrecht, 112½ miles; the fourth to Brussels, 93¾ miles; the fifth to Roubaix, 56¼ miles; the sixth to Calais, 62½ miles; the seventh to London, 93¾ miles. The return trip from Calais was made *via* Amiens, in a straight line to Vincennes, 136½ miles.

The start of the race was as systematic as is the start of a big automobile race. The machines started from three parallelograms at intervals of 2 or 3 minutes. After the gun sounded at 6 o'clock, Tabuteau, on a Bristol biplane, Vedrines on a Morane monoplane, and Bathiat on a Sommer monoplane, were off inside of 3 minutes. It is estimated that a quarter million people witnessed the start and cheered the aviators. Within 20 minutes Tetard, Kimmerling, Lieut. Conneau, Gaget, Garros, Molla, Vidart, Wynmalen, Morin, and Pedrot were on their way. They were soon followed by Biellovucci, Amerigo, Pascal, Duval, Bobba, Count Dhesbel, Loridan, Contenes, Charlix, La Bouret, Le Lasseur, Prince De Nissole, Allard, Weymann, Barra, Gibert, Valentine, Marquis de Romance, Landron, Morison, Bille, Le Martin, Verrep, Euhlind, Balger, and

last of all, Emile Train, the aviator whose machine killed Mons. Berteaux, the Minister of War, at the start of the Paris-Madrid race.

Besides the usual number of withdrawals owing to poor starts, the race was marred by three fatal accidents which occurred within a short distance of the aerodrome. The nearest of these was the accident to Le Martin, who had had trouble with his rudder and had been advised by Garros not to start. He started twenty-sixth on the list, however, and no sooner was he in the air than it was seen that he had lost control of his machine, which bobbed up and down dangerously. He had risen to about 200 feet and was straightening out on his way, when suddenly the machine began to pitch about in a terrifying manner just as he was passing over a patch of woods. Le Martin shut off the motor and attempted to glide to the ground, but a gust of wind drove the machine to earth and upset it. The aviator was pinned to the ground and his skull was terribly crushed. He died a few minutes after he had been taken to the hospital.

The other fatal accidents were much more spectacular. The first of these happened to Capt. Princetau, a young lieutenant who had just been gazetted the day of the race. He had been ordered to accompany the racers and was flying at Issy-les-Molineaux, at a height of some 75 feet, when suddenly his machine burst in flames and dove to the ground. So hot was the fire that the captain's fellow officers were unable to get him out of the wreckage, and he was burned to death beneath it, if indeed he was not burned and rendered unconscious before the machine struck the ground.

The second aviator to meet a similar fate was Landron, who flew a De Pishof monoplane. He was flying above Chateau Thiery at an elevation of about two thousand feet, when his machine burst into flames and fatally burned the aviator during its drop to the ground. We reproduce photographs of the De Pishof monoplane in flight and on the ground. It will be seen that this machine differs materially from the usual type of monoplane. It was fitted with a 70 horse-power, 4-cylinder Labor motor in place of the revolving cylinder Gnome which was used on Lieut. Princetau's Blériot. How these machines came to catch fire in flight, and the ever-present danger of such an occurrence, is discussed elsewhere in our columns.

The automobile-like De Pishof monoplane viewed from the front.

The De Pishof monoplane in flight.

Besides the fatal accidents above mentioned there were several other accidents that were rather serious. Lieut. Gaubert fell near Soissons and was found lying unconscious in a wheat field. Bielle fell within a mile of the start and was badly bruised, and Loridan, Morison and Morin also made heavy landings and received a severe shaking-up. The last named was within twenty miles of Liege when he met disaster. The aviators who reached Liege the same day were Vidart, in 3 hours 13 minutes; Vedrines, in 3 hours and 33 minutes; Weymann, on a Nieuport monoplane, in 3 hours and 55 minutes; Lieut. Conneau, in 4 hours and 2 minutes; Barra, on a Farman biplane, in 4 hours and 3 minutes; Duval, on a Caudron biplane, in 4 hours and 31 minutes; Garros in 5 hours and 3 minutes, and Renaux (the only contestant carrying a passenger) in 13 hours and 55 minutes. After a rest of two days, during which time ten more of the aviators had arrived at Liege, 14 of them made the flight to Spa and return. On May 22nd the second real stage of 130 miles to Utrecht was flown. Vedrines smashed two machines and was obliged to get a third. Seven aviators reached Utrecht in the following order: 1, Gibert (Blériot); 2, Vidart (Deperdussin); 3, Garros (Blériot); 4, Lieut. Conneau (Blériot); 5, Weymann (Nieuport); 6, Kimmerling (Sommer); 7, Train (Train). All the aviators were bothered by a strong and gusty wind. Amerigo capsized when ascending at Liege. He was thrown out and seriously injured. Renaux and Le Lasseur both fell and the latter was rather badly injured. Duval descended near Venlo, and Barry broke down near Randwyk.

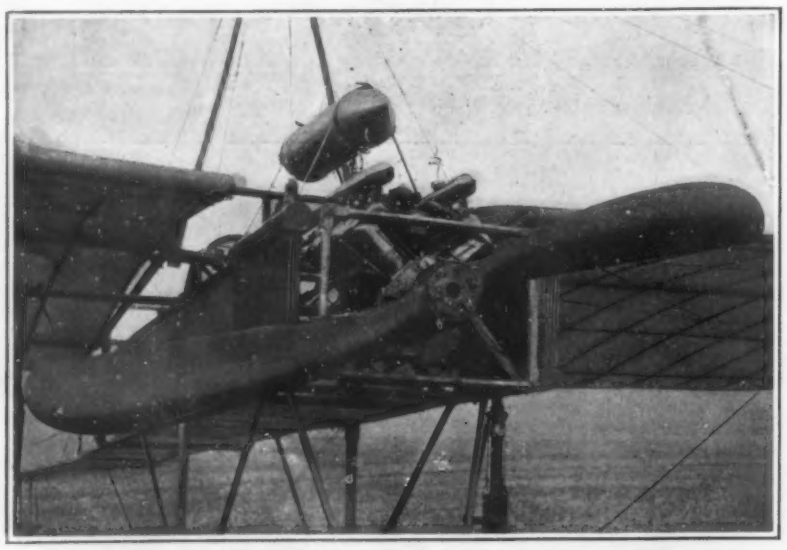
The third stage of the race, 93¾ miles from Utrecht to Brussels, was flown on Friday, June 23rd, but no reports have been received of this stage up to the time of our going to press.

PARIS—ROME—TURIN.—Table of characteristics of entered machines.

Pilot and Machine.	Supporting Area.	Weight. Empty.	Weight. Flying.	Span.	Length.	Balancing.	Under carriage.	Suspension.	Control. Elevator.	Control. Balance.	Control. Rudder.	Engine. Make.	Engine. h.p.	Engine. Cyls.	Engine. Bore.	Engine. Stroke.	Propeller. Make.	Propeller. Diameter.	Propeller. Pitch.	Propeller. Blades.	Propeller. Speed.	Flight Speed.
	sq. ft.	lbs.	lbs.	ft. ins.	ft. ins.													ft. in.	ft. in.		r.p.m	m.p.h
Niemela (Nieuport) ...	196	750	1100	33 0	27 7	W	W & s	S	Pedal	Lever		Gnome	50	7	110	120	Integrale	8 7	5 5	2	1100	72
Bathiat (Sommer) ...	182	580	900	34 9	29 8	W	W & s	R	Lever	Bar		,,	50	7	110	120	Rapid ...	8 6	5 4	2	1100	59
Leinasson (Caudron) ...	235	550	880	26 4	26 4	W	W & s	R	,,	,,		Anzani	60	6	105	125	Normale	— —	— —	2	—	59
Vidart (Deperdussin) ...	150	495	825	29 8	23 0	W	W & s	R	Wheel	,,		Gnome	50	7	110	120	Rapid ...	8 3	5 4	2	1100	62
Molla (Sommer) ...	182	580	900	34 9	29 8	W	W & s	R	Lever	,,		,,	50	7	110	120	,, ...	8 3	5 4	2	1100	59
Beaumont (Blériot) ...	187	505	835	29 4	26 8	W	Wh	R	,,	,,		,,	50	7	110	120	Integrale	8 7	5 5	2	1100	59
Tetart (Bristol)	454	800	1100	34 9	38 7	F	W & s	R	,,	,,		,,	50	7	110	120	,,	9 3	5 4	2	1100	50
Bielovucic (Voisin) ...	342	1100	1590	36 4	34 9	F	Wh	S	Bar	Wheel		,,	70	7	130	120	Voisin ...	8 7	6 7	2	1200	62
Lusetti (Morane) ...	187	440	770	30 7	22 1	W	W & s	R	Lever	Bar		,,	50	7	110	120	Integrale	9 3	5 4	2	1100	62
Kimmerling (Sommer) ...	182	580	900	34 9	29 8	W	W & s	R	,,	,,		,,	50	7	110	120	Rapid ...	8 6	5 4	2	1100	59
Landron (Autoplan) ...	288	790	1140	36 4	29 8	F	W & s	R	,,	,,		Labor	70	4	100	160	Integrale	9 10	6 7	2	900	50
Védrines (Morane) ...	187	790	1140	30 7	22 1	W	W & s	R	,,	,,		Gnome	50	7	110	120	,,	8 7	5 5	2	1100	62
X— (Ch. Joly) (Voisin)	450	1100	1540	36 4	34 9	F	Wh	S	Bar	Wheel		,,	50	7	110	120	Voisin ...	8 0	5 4	2	1100	50
Level (Savary)	555	1210	1540	46 3	29 8	F	W & s	R	Lever	Bar		Labor	70	4	100	160	Integrale	8 10	6 7	2	800	56
Gaget (Morane)	187	440	770	30 7	22 1	W	W & s	R	,,	,,		Gnome	50	7	110	120	,,	8 7	5 5	2	1100	68
Tabuteau (Bristol) ...	454	800	1100	34 9	38 7	F	W & s	R	,,	,,		,,	50	7	110	120	,,	9 3	5 4	2	1100	50
A. Frey (Morane) ...	187	440	770	30 7	22 1	W	W & s	R	,,	,,		,,	50	7	110	120	,,	8 7	5 5	2	1100	68
Garros (Blériot)	187	505	835	29 4	25 0	W	Wh	R	,,	,,		,,	50	7	110	120	,,	8 7	5 5	2	1100	59
Prince de Nisiole (Tellier)	256	680	1100	39 0	36 4	W	Wh	S	Wheel			R. E. P.	60	5	110	160	,,	— —	— —	2	—	46
Weymann (Nieuport) ...	196	750	1100	33 0	27 7	W	W & s	S	Pedal	Lever		Gnome	70	7	130	120	,,	8 10	6 7	2	1200	78
Manissero (Blériot) ...	187	505	835	29 4	25 2	W	Wh	R	Lever	Bar		,,	50	7	110	120	,,	8 7	5 5	2	1100	59

Notes.—W = Warping. F = Flaps. W & s = Wheels and skids. Wh = Wheels. R = Rubber. S = Springs.

Table by courtesy of *Flight*.



LEFEVRE MONOPLANE, SHOWING IMPROPER ARRANGEMENT OF GASOLINE TANK

Arrangement of Motors and Fuel Tanks on Aeroplanes

ON OUR editorial page we call attention to the danger from fire on present-day aeroplanes and make suggestions regarding the location of the gasoline tank in a safer position than one in proximity to the motor. The Gnome motor, which is so widely used on the modern machines, is in some cases surrounded by a steel ring or casing which keeps the oil from flying out by centrifugal force and coming back in the face of the aviator. A section of the ring is missing at the bottom part, for it is at this point that the exhaust valve of each cylinder is open and that the burning gases are allowed to escape into the air. As no carbureter is used in this motor, the gasoline being fed through a jet into the horizontal hollow stationary crankshaft, there is no danger of the machine catching fire from the carbureter in the way we have stated. In Lieut. Princetau's case the machine is said to have burst into flames and to have set fire to the aviator's clothing while he was 75 feet in the air. It is difficult to explain how this happened. In all probability there was a gasoline leak near the motor, and the fuel, trickling down through the floor, caught fire from the burning exhaust gases as they shot out underneath the machine. The flames were driven back at the aviator by the speed of the aeroplane through the air, and no doubt the gasoline tank ignited the moment he struck the ground.

One of the illustrations on this page shows the Henri Lefevre monoplane (which is one of the newest French machines) fitted with an 8-cylinder V-type motor. The radiators are shown on each side of the body and the gasoline tank above and slightly to the rear of the engine; the carbureter can be plainly seen between the cylinders at the front. This arrangement of the gasoline tank is a very dangerous one and one that should be avoided. If by any chance the carbureter should catch fire, the flames would instantly strike the gasoline tank, melt any soldered joint in the piping or tank, and deluge the motor and machine with a flood of gasoline; the result would be a terrific conflagration and the aviator would have no chance of escape. There is also a possibility of an explosion in case the gasoline tank should happen to be only partially filled. The arrangement of the tank on the Lefevre monoplane is therefore one that should be avoided.

Turf as a Filter

RECENT experiments in France have shown that natural turf is an excellent material from which to form beds for the filtering of sewage. A volume of between three and four cubic meters of sewage can be purified every day for every square meter of the surface of the turf. A turf filter that has been in use for some time shows no diminution of efficiency. If a larger proportion of sewage than that mentioned is employed the filter proves less effective, but it recovers its power when the amount of sewage is reduced to the proper proportion. Chemical analysis and the effects upon fish put into the filtered water unite in testifying to the efficiency of the process.

Air Consumed in One Minute

IN one minute, in a state of rest, the average man takes into his lungs about 8 liters or 48.8 cubic inches of air. In walking, he needs 16 liters or 97.6 cubic inches; in climbing, 23 liters or 140.3 cubic inches; in riding at a trot, 33 liters or 201.3 cubic inches; and in long distance running, 57 liters or 347.7 cubic inches.

One Hundred and Forty-four Postal Cards per Second

A New Machine for the Public Printer

By Thomas D. Gannaway

WHETHER the government ownership of certain public utilities would be an advantage to the mass of people, is a much mooted question. But Mr. Samuel Donnelly, Public Printer, is thoroughly demonstrating the fact that the government ownership of postal card presses is a case of real economy to the United States Government. Until the beginning of the present fiscal year, postal cards have been printed under annual contract by private concerns. This necessitated a great deal of unnecessary trouble and expense to the Government.

The Government Printery naturally must keep abreast with the rapid growth of the public business. It has, therefore, been enlarged from time to time, until it to-day is the largest printing establishment in the world.

Last year, when bids for the printing of postal cards for the next ensuing fiscal year were asked for, Mr. Donnelly, the Public Printer, wishing to serve "Uncle Sam"—his employer—to the best of his ability, submitted a bid for the job. The printing of the little one-cent postal cards for one year is a tremendous undertaking, and the making up of the bid requires very accurate figuring. It is claimed by the contractor of last year that he lost money. He would not bid for the job again, which is good evidence of the truth of his assertion. When the bids were opened by the department, it was found that the Public Printer was the lowest bidder. There was some criticism at the time on the Government's undertaking to do this work. This must have been due to the critic's lack of knowledge of the ability of the Government Printing Office to do the task. There is no private concern as well equipped to do this job, and do it as economically, as the Government. Again, a private firm, not having any assurance of getting their contract renewed, could not afford to invest in the proper machinery, which must, necessarily, be of a special design, to produce the best results. The private contractors, therefore, were compelled to use the ordinary straight sheet press; while, as may be seen from the accompanying cuts, the Government is using very large rotary presses especially designed for this work. It was thought, until within the last few months, that such work could not be done on the rotary style of press. The use of such press greatly increases the speed with which the cards can be printed, thereby diminishing the cost of them. The two rotary presses now in use have a capacity of over two million postal cards each in eight hours. It would be preposterous to think of an ordinary flat sheet press approaching half of this capacity.

The paper on which the cards are printed is wide enough to allow eight cards to be printed lengthwise across it. Each roll weighs one thousand pounds net. Ordinarily there is great waste in handling this size roll of paper, by hauling it on trucks, standing it on end, tumbling it about from place to place, and incidentally dropping it. In order to prevent this wastage, and at the same time save the expense of handling it so much, Mr. Donnelly conceived the idea of building a structural iron rack to hold the stock of postal card paper. As will be seen from Fig. 1, this rack consists of three tracks, one over the other. At either end of it is an overhead track, on which is mounted a portable lift.

A large ball-bearing truck, drawn by two horses, is used to haul the paper from the freight station. It carries six rolls of eleven hundred pounds gross each at a load. A load is pulled up to an entrance to the postal card department, where the overhead track referred to extends out over the driveway; then the portable lift is run out over the loaded truck, a piece of three-inch pipe is run through a roll of paper, the lift is hooked onto each end of the pipe, and, although the roll weighs eleven hundred pounds, one man hoists it up and runs the lift back to the end of the rack, where the roll of paper is swung around into place. Small two-wheel trucks are placed under each end of the three-inch pipe and on a monorail on each side of the rack, then pushed on to make room for the next one. This rack is two hundred and ten feet long and has a storage capacity of two hundred and eighty thousand pounds of paper at one time. When one deck of the rack is filled, a large cable which extends from the delivery end to the receiving end and back is thrown over the whole row on that deck, and by winding up one end of it the rolls of paper are pulled down to the delivery end as they are needed. Overhead lifts, the same as are used to unload the trucks, are used to transfer the paper from the rack to the presses, as shown in Fig. 2. The roll is picked up out of the rack in the same way as it is lifted off the truck, and is carried to the press. It is then let down on the floor and the chock is fastened in it; the roll is then again picked up by the lift, and by means of a switch in the overhead track it is carried and put in its exact place on the press. After the roll has been placed in the press, the wrapper is removed and the end of the paper is attached to that already in the press by means of a piece of adhesive tape, thus practically eliminating all wastage at the start. Notwithstanding the fact that the paper is wound on large metal cores, there are several rounds which cannot be used successfully on rotary presses. Ordinarily this would be wasted, but it is stripped off, cut into sheets of a certain size and used for making other official cards which the Government has to have. Thus the wastage is practically nothing.

Fig. 1.—This rack is 210 feet long and holds 280,000 pounds of postal card paper.

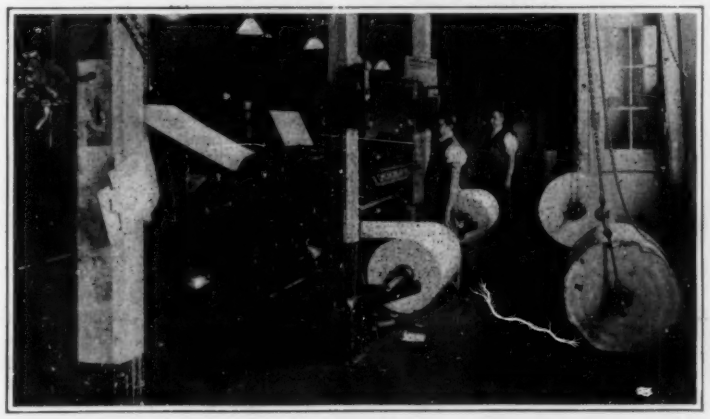


Fig. 2.—The two card-printing presses with a capacity of nearly two and one-half million postal cards per day.

Fig. 3.—Press for printing reply cards.

A NEW MACHINE FOR THE PUBLIC PRINTER

Each press has two cylinders, containing several cuts each, from which the cards are printed. The two cylinders make it possible to print the reply postal cards—which must be printed on both sides—at one operation. When the ordinary postal card is printed, only one printing cylinder is used. The press shown in Fig. 3 is printing the reply cards. These are automatically cut, leaving one message and one reply card attached together. When the paper has passed over the printing cylinder it passes under a slitter, which trims the outer margins and slits the paper into eight strips, just as wide as one postal card is long.

These strips then pass under a cutter which strikes them at a speed of no less than nine strokes per second, cutting eight cards at a stroke, making seventy-two cards per second. When printing the reply cards the cutter is so adjusted as to make just half as many strokes per second. The cards are dropped in eight stacks, until these contain twenty-five each, then they are automatically carried out on the receiving table, where there are eight attendants to receive them. Each of them takes a pack, fastens a paper band around it, and drops it in a box. When the packs are coming at the rate of eight every three seconds, it is easy to see that there is no time to lose. Mr. Donnelly tells me that two machinists are working on an attachment for these presses which will strap the packages automatically. When this is completed it will diminish the cost of producing the cards several hundred dollars per year.

It has been the custom of the Post Office Department to ship the cards to large offices in wooden boxes holding ten thousand cards. They now use containers made of cardboard. By weighing we found that the one made of wood weighed ten and three-fourths pounds, while the one made of cardboard weighed one and seven-eighths pounds. There are about ninety thousand of these containers used per year. Thus the Government is saved the transportation charges on eight hundred thousand pounds of surplus casing in one year. The containers are filled and sealed near the press, then stacked on a portable platform. When the platform contains as many packages as one man can readily haul on a four-wheeled truck, the truck is backed under it, and by turning a crank at one end certain parts of the truck floor are forced up at each corner, thus lifting the loaded platform off its supports and letting it rest on the truck. It is then taken to the shipping room and let down on other supports, thereby saving the time of at least two laborers.

Table of American Aeronautic Motors

Complete Specifications of the Motors of Thirty-four Manufacturers

Compiled by E. L. Jones and S. Y. Beach

Name.	Bore and Stroke.	Manufacturers' Rating.	A.L.A.M. Rating.	Number Cylinders	Cycle.	Arrangement of Cylinders	Intake Valve.	Compression, Lbs.	Con. Rod Bearings.	Crankshaft Bearings.	Carbureter.	Cooling.	Oiling.	Ignition.	Material Pistons.	Material Cylinders.	Weight, Pounds.
Aircraft	4½ × 5	40	32	4	4	Vertical.	M.	80	....	....	Choice.	El Arco.	F. F. & Sp.	Bosch.	G. I.	G. I.	125
Aircraft	4½ × 5	80	65	8	4	"V."	M.	80	....	....	Choice.	El Arco.	F. F. & Sp.	Bosch.	G. I.	G. I.	210
Aircraft	4½ × 5	160	130	16	4	"V."	M.	80	....	....	Choice.	El Arco.	F. F. & Sp.	Bosch.	G. I.	G. I.	335
* †† A.-M	3½ × 3½	35	34	7	4	Radial.	M.	85	H.-B.	H.-B.	Schebler.	Air.	F. F.	Mea.	G. I.	Nick. Steel.	125
* ‡ A.-M	2¾ × 2½	35	29	6	2	Radial.	None.	80	H.-B.	H. B.	Own.	Air.	F. F.	Mea.	G. I.	Nick. Steel.	90
Ashmesch	3½ × 3½	25	22	4	4	Horizont.	A.	75	Bronze.	Bronze.	Indiv. Ash.	Air.	F. F.	Mag.	C. I.	Steel.	124
* Avis	5½ × 5	30	34	2	2	Opposed.	None.	75	Bronze.	R. I. V.	Schebler.	Air.	Oil in Gas.		G. I.	G. I.	98
Boland	4 × 4	60	51.2	8	4	"V."	A.	72	Bronze.	Brz. & Ball.	Mayer.	Water.	F.	B. or Mea	C. I.	C. I.	262
Boulevard	4½ × 4½	30	32	4	4	Vertical.	M.	90	....	....	Choice.	El Arco.	F. F. & Sp.	Bosch.	G. I.	G. I.	150
Boulevard	4½ × 4½	60	64	8	4	"V."	M.	90	....	....	Choice.	El Arco.	F. F. & Sp.	Bosch.	G. I.	G. I.	255
Broderick	5 × 5	40	40	2	2	Vertical.	A.	75	Bronze.	Bronze.	Choice.	Water.	F. F. & Sp.	Bosch.	C. I.	Nick. Steel.	150
Brott	4½ × 4½	45	32	4	4	"V."	M.	70	....	....		Water.	F. F.	Mea.	C. I.	C. I.	175
Call	6 × 5½	50	29	2	4	Opposed.	M.	90	Bronze.	Ball.	Schebler.	El Arco.	F. F.	Choice.	G. I.	C. I.	185
Call	6 × 5½	100	58	4	4	Opposed.	M.	90	Bronze.	Ball.	Schebler.	El Arco.	F. F. & Sp.	Choice.	G. I.	C. I.	325
Curtiss	3½ × 4	25	23	4	4	Vertical.	M.	..	....	....	Schebler.	El Arco.	F. F. & Sp.	Bosch.	McAdam ite & C. I.	G. I.	130
Curtiss	4 × 4	50	51	8	4	"V."	M.	..	....	....	Schebler.	El Arco.	F. F.	Bosch.		G. I.	250
DeCaesne	5 × 5	50	40	4	4	Vertical.	M.	74	....	....	Schebler.	El Arco.	F. F. & Sp.	A. K.	C. I.	C. I.	280
Detroit Aero	5½ × 5	20-30	24	2	4	Opposed.	M.	90	Die Cast.	N. D. Ball.	Schebler.	Air.	F. F.	Bosch.	C. I.	C. I.	149
† Elbridge	4½ × 4½	40	55	4	2	Vertical.	None.	60	Brz. & Bab.	Babbitt.	G. & A.	El Arco.	Oil in Gas.	Bosch.	G. I.	G. I.	198
Elbridge	4½ × 4½	60	84	6	2	Vertical.	None.	60	Brz. & Bab.	Babbitt.	G. & A.	El Arco.	Oil in Gas.	Bosch.	G. I.	G. I.	....
Emerson	5 × 5	40	40	4	4	Vertical.	A and M.	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	El Arco.	Oil in Gas.	Mea or Atwater-Kent.	Spc. I.	Spc. I.	312
Emerson	5 × 5	60	60	6	4	Vertical.	A and M.	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	El Arco.	Oil in Gas.		Spc. I.	Spc. I.	
Emerson	5 × 5	65	65	4	2	Vertical.	None.	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	El Arco.	Oil in Gas.		Spc. I.	Spc. I.	
Emerson	5 × 5	100	98	6	2	Vertical.	None.	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	El Arco.	Oil in Gas.		Spc. I.	Spc. I.	348
Emerson	6 × 6	80	72	5	4	Radial.	M.	..	Bronze.	Bronze.	Own.	Air.	Mechanical.	Duplex.	....	....	280
* Farwell	3½ × 3½	24	32	4	2	Vertical.	None.	..	....	Babbitt.	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	....
Fox	3½ × 3½	36	48	6	2	Vertical.	None.	..	....	Babbitt.	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	....
Fox	4½ × 4½	60	59	4	2	Vertical.	None.	..	....	Babbitt.	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	....
Fox	4½ × 4½	90	80	6	2	Vertical.	None.	..	....	Babbitt.	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	....
*Gyro	4¼ × 4½	60	50	7	4	Radial.	M.	Variable.	Ball.	Ball.	Schebler.	Air.	Oil in Gas.	....	Conv. Steel.	Nickel Steel	....
Hall-Scott	4 × 5	40	51	4	4	Vertical.	M.	82	....	....	Stromberg.	Hall-Scott.	F. F. & Sp.	Bosch or Mea.	C. I.	C. I.	150
Hall-Scott	4 × 5	80	51	8	4	"V."	M.	82	....	....	Stromberg.	Hall-Scott.	F. F. & Sp.		C. I.	C. I.	270
Hall-Scott	4 × 4	30	26	4	4	Vertical.	M.	82	....	....	Stromberg.	Hall-Scott.	F. F. & Sp.		C. I.	C. I.	142
Hall-Scott	4 × 4	60	52	8	4	"V."	M.	82	....	....	Stromberg.	Hall-Scott.	F. F. & Sp.		C. I.	C. I.	265
H-Dek	4½ × 5	30-40	33	4	4	Vertical.	A.	72	Bronze.	Bronze.	G. & A.	Water.	M. & Sp.	Mea.	C. I.	Steel.	160
H-Dek	5½ × 6	60-80	43	4	4	Vertical.	A.	85	Bronze.	Bronze.	G. & A.	Water.	M. & Sp.	Mea.	C. I.	Steel.	255
Indian	4 × 4½	50	51	8	4	"V."	M.	..	....	....	Indian.	Water.	F. F.	Bosch.	....	....	275
* Indian	4½ × 4½	50	53	7	4	Radial.	M.	..	Ball.	Ball.		Air.	F. F.	Bosch.	....	....	..
Kirkham	4½ × 4½	50	41	6	4	Vertical.	Sliding sleeve	90	Babbitt.	Babbitt.	Choice.	Water.	F. F. & Sp.	Simms.	C. I.	C. I.	235
Kirkham	4½ × 4½	55	45	6	4	Vertical.	Sliding sleeve	90	Babbitt.	Babbitt.	Choice.	Water.	F. F. & Sp.	Simms.	C. I.	Nickel Steel	205
Leighton	5 × 4½	40-50		4	2	Vertical.	M & A.	50	Bronze.	Babbitt.	Schebler.	R. T. Co.	Oil in Gas.	A. K., B.	C. I.	C. I.	285
* Macomber	4½ × 4½	50	50	7	4	H'rizont'l	M.	Variable.	Ball.	Ball.	Choice.	Air.	S. P.	Bosch.	C. I.	C. I.	240
Maximotor	4½ × 4½	30-40	32	4	4	Vertical (*en bloc*).	A.	65	Nickel Bab.	Hess-Bright.	Schebler.	Detroit and El Arco	F. F. & Sp.	Mea.	Van G. I.	Van G. I.	190
Maximotor	4½ × 4½	50-60	48	6	4		A.	65	Nickel Bab.	Hess-Bright.	Schebler.		F. F. & Sp.	Mea.	Van G. I.	Van G. I.	260
Maximotor	5 × 5	40-50	40	4	4		A.	65	Nickel Bab.	Hess-Bright.	Schebler.		F. F. & Sp.	Mea.	Van G. I.	Van G. I.	230
Maximotor	5 × 5	60-75	60	3	4		A.	65	Nickel Bab.	Hess-Bright.	Schebler.		F. F. & Sp.	Mea.	Van G. I.	Van G. I.	300
Metz	4 × 4	30	26	4	4	Vertical.	M.	..			Own.	Water.	F. F. & Sp.	Bosch.	C. I.	C. I.	155
* Metz	6½ × 6½	120	126	7	4	Radial.	M.	..	Ball.	Ball.	Own.	Air.	Sp.	Bosch.	Steel.	Steel.	375
* Metz	4½ × 4½	58	57	7	4	Radial.	M.	..	Ball.	Ball.	Own.	Air.	Sp.	Bosch.	Steel.	Steel.	140
* Metz	3½ × 3½	35	34	7	4	Radial.	M.	..	Ball.	Ball.	Own.	Air.	Sp.	Bosch.	Steel.	Steel.	130
Rines	4 × 4	30	26	4	4	Vertical.	M.	..	Bronze.	White Brass.	Schebler.	El Arco.	F. F.	Bosch.	G. I.	G. I.	130
Rinek	4 × 4	50	51	8	4	"V."	M.	..	Bronze.	White Brass.	Schebler.	El Arco.	F. F.	Bosch.	G. I.	G. I.	285
Roberts	4½ × 5	50	52	4	2	Vertical.	Rotary.	75	Brz. & Bab.	Nickel Bab.	Kingston.	El Arco.	Oil in Gas.	Bosch.	G. I.	Aerolite.	190
Roberts	4½ × 5	75	79	6	2	Vertical.	Rotary.	75	Brz. & Bab.	Nickel Bab.	Kingston.	El Arco.	Oil in Gas.	Bosch.	G. I.	Aerolite.	260
* Rotary	3½ × 3½	35	34	7	4	Radial.	M.	..	Hess. Bright. Ball.	Hess. Bright. Ball.	Schebler or G. & A.	Air. Air. Air. Air.	F. F. F. F. F. F. F. F.	Bosch or Mea.	....	Nick. Steel.	140
* Rotary	4½ × 4½	50	50	7	4	Radial.	M.	..							....	Nick. Steel.	175
* Rotary	4½ × 4½	70	63	7	4	Radial.	M.	..							....	Nick. Steel.	200
* Rotary	4½ × 4½	100	101	14	4	Radial.	M.	..							....	Nick. Steel.	250
Gray Eagle	4½ × 4½	30-40	29	4	4	Vertical.	Automatic.	50	Nickel Alloy.	Nickel Alloy.	Schebler.	Air.	S. F. & S.	Bosch.	C. G. I.	30% Car. Stl.	182
† Smalley	4½ × 4½	20-100	25-80	2-6	2	Vertical.	None.	..	Babbitt.	Babbitt.	Schebler.	Water.	Oil in Gas.	Mea.	G. I.	Al. St'l Lin	103-316
* Stenzy	4 × 4	25	13	2	4	Tangent.	A.	70	....	....	Schebler.	Air.	Oil in Gas.	Bosch.	G. I.	G. I.	65
* Stenzy	4 × 5	50	13	2	4	Tangent.	A.	70	....	....	Schebler.	Air.	Oil in Gas.	Bosch.	G. I.	G. I.	80
* Stenzy	5 × 5	200	40	4	4	Tangent.	A.	70	....	....	Schebler.	Air.	Oil in Gas.	Bosch.	G. I.	G. I.	300
Waterman	4 × 4	24-30	38	4	2	Vertical.	A.	60	Bronze.	Special Bab.	Br.-Detroit.	Water.	Oil in Gas.	Bosch.	Iron.	I., Cop., Ja.	190
‡‡ Whitehead	4¼ × 4¼	30-40	43	4	2	Vertical.	A.	90	Bronze.	Bronze.	Schebler.	El Arco.	Splash.	Bosch.	C. I.	Steel.	130
Wolverine	5½ × 5	25-30	24	2	4	Opposed.	Mechanical.	65	Bronze.	Die Castings.	Schebler.	Air.	Oil in Gas.	Bosch.	G. I.	G. I.	160

WEIGHT.—The weight asked for was to cover "all essential parts, including carbureter, ignition system, lubricator, radiator, ready for fuel to start." The figures printed are those given us under this condition, unless otherwise specified in table.

BLANKS.—Dotted lines are used where information has been requested and not supplied.

A. L. A. M. RATING.—The A. L. A. M. formula is bore squared, times the number of cylinders, divided by 2.5. The result times 1⅝ gives one rating, used above, for 2-cycle engines.

* Rotating motors. † The Elbridge Company makes six sizes as does the General Machinery Company. †† This is also made in 50, 70 and 100 horse-power sizes. ‡ Made also in 50, 70, 100 and 150 horse-power sizes.

‡‡ Other sizes are 40 and 60 horse-power. The same sizes are also made in four-cycle engines.

Campaniles, Medieval and Modern

The Bankers' Trust Building—Successful Solution of a Difficult Architectural Problem

FREQUENTLY during the past few years the SCIENTIFIC AMERICAN has drawn attention to the fact that, since the modern "sky-scraper" office building has been carried up to a height which renders it nothing more nor less than a tower, the architect should treat it as such and accentuate, in his treatment of the exterior, the vertical at the expense of the horizontal lines. Frequently in earlier designs the opposite course was followed, and an attempt was made to reduce the appearance of height by running across the façade at regular intervals heavy, projecting, cornice-like bands of masonry, thus giving to the building the appearance of a series of separate structures mounted one above the other. The result was deplorable.

In the more recent tall buildings, however, our architects have frankly accepted the situation. In some cases they have taken the medieval campanile as their model; in others, they have obtained successful effects, as seen in some of the competitive designs shown at architectural exhibitions, by embodying, in a broad way, the principal elements of the classic column—base, shaft, capital, frieze and cornice.

The most recent of the "tower" buildings to be erected in this city is a magnificent pile of steel and granite which stands at the corner of Nassau and Wall streets, and will be known as the Bankers' Trust Building. From a base approximately 95 feet square it rises to an extreme height of 540 feet above street level. The proportions and outline of the structure are those of the medieval campanile; the details are pure Greek; and the combination has been so successfully carried through, that we believe it will be the general consensus of opinion that the architects, Messrs. Trowbridge & Livingston, have produced in this structure the most harmonious and dignified building of its type in this or any other American city. Particularly are they to be commended for heightening the æsthetic appearance of the structure by abolishing all windows from the pyramidal structure which forms the huge capstone of the tower, and carrying up the stone work in a series of massive steps ratner than in plane surfaces. The many-windowed pyramid is an anachronism of the most painful kind; whereas the stepped surface is perfectly harmonious with classic ideas, being suggestive, indeed, in the present case, of the ancient mausoleum of Halicarnassus.

By way of accentuating at once both the similarities and the differences between the medieval and the modern campanile, our artist has imposed his drawing of the Bankers' Trust Building upon a photograph of the famous St. Mark's Square, Venice. The modern building has been placed at the same distance from the eye as the old Venetian campanile, so that the two appear upon the same scale, and the observer receives a just impression of their relative heights and other proportions. The Venetian tower stood 323 feet in height upon a base which was approximately 42 feet square. It will be noted at once that the pyramidal portion of the Venetian tower has a much steeper inclination; in which respect the pyramidian of the Metropolitan Building follows more nearly the Venetian model. The inclination of the Bankers' Trust walls is 70 degrees, and that of the mausoleum of Halicarnassus was 45 degrees. We think it will be agreed that the architects have adopted a judicious compromise.

Before passing to a description of the engineering and constructional features of the building, it is well to mention here that the preparation of the site involved the purchase and complete removal of the Gillender Building, built less than fifteen years ago, a modern eighteen-story steel-and-stone structure, which stood on a limited plot at the corner of Nassau and Wall streets. For the reason that its rentable floor surface was too greatly reduced by the elimination of the space necessary for elevators, stairways and corridors, this building had never been a paying proposition. To allow the old building to stand and carry the new structure around it in the form of an L, would have been to cut out the major portion of the light and air—elements of prime importance in determining the rentable value of a modern office building. It took only a few minutes figuring with pencil and pad to prove that it would be a more profitable investment to buy and destroy this eighteen-story steel building, and erect a new thirty-story structure upon the whole corner plot, 97 by 94½ feet, thus secured.

Alike in the wrecking of the old building, the preparation of the foundations and the erection of the new structure, all previous records for rapid work have been surpassed, as the following dates will show. The wrecking of the Gillender building was commenced April 29th, 1910. Forty-five days later it had disappeared. On June 15th work on the foundations commenced; and on November 1st, 1910, the first steel columns of the new building were erected. By June 6th, 1911, the steel work had been carried up complete to its full height of 592 feet above the foundation footings, and by September 1st, the stone work will have been finished also. The erection of the stone work, by the way, has been particularly rapid, the average rate of progress having been 3½ stories per week. Such expeditious work has been due mainly

to three causes; first, that all office work upon plans, etc., has been done far in advance of the building, this being true of the smallest details; secondly, that the granite work, even to the cutting out of the checks to receive the projecting portions of the steel, was completed before the stone was shipped to the site; and, thirdly, that the contractors, Marc Eidlitz & Sons, had perfected an organization by which material was brought to the building only as it was required and always slightly in advance of the demands of the erectors.

We dwell at some length upon this feature, since it is largely in standardization of materials, accurate shop work, and highly specialized organization of the erection forces at the site, that American architects and builders have succeeded in prosecuting their work at a speed which is not approached in any other part of the world. As an instance of high-class erection, it may be recorded that the work of Post & McCord, who had the contract for the steel, was so accurate that the columns, in the course of their progress to a total height of nearly 600 feet, have not varied more than a quarter of an inch from the plumb line. That this speed of erection has not been due to reckless haste is shown by the fact that it was marked by but one accident.

Although, architecturally speaking, the chief interest in this building is to be found above street level, its interest from the engineering standpoint lies in the work which has been done below the sidewalk, in preparing the foundations. Here a system has been adopted which the architects believe is destined, because of its many advantages, to become standard practice in lower Manhattan. The old method of preparing foundations was to sink concrete-filled caissons through the water-soaked sand and silt, which overlie the bed rock, and erect upon these the footings for the steel columns. Usually a caisson was sunk for each line of columns. These caissons which would be anywhere from 8 to 25 feet in their largest diameter, naturally occupied a large amount of the valuable space below street level, which is used for basement, engine room, storage and other purposes. Furthermore, there were objections to this method, due to the difficulty of waterproofing and excluding moisture from the steel footings of the columns.

The new system, as adopted in the Bankers' Trust Building, is to sink a continuous steel-and-concrete cofferdam wall entirely around the plot on which the building is to be constructed, extending the wall everywhere down to solid rock, with which it forms a water-tight contact, and carrying it up everywhere above water level. When the wall, which is 7 feet in thickness throughout, had been completed, the sand and silt and the caissons of the old Gillender Building were removed, until the underlying rock was exposed. During the progress of excavation a framework of heavy timber struts was built from wall to wall, for the purpose of counteracting the outside pressure of the water-soaked silt, which reached a maximum of 3,360 pounds per square foot. When the excavation had been completed, the footings for the foundations of the steel columns were prepared, and the erection of the steel skeleton commenced. On the sides of the plot contiguous to existing buildings, the columns were erected upon the cofferdam wall. On the sides abutting on the streets, the footings were placed on the solid rock contiguous to the wall.

The advantages of this system of construction are several. In the first place, the steel work is open to inspection right down to the mother rock. In the second place, the exceedingly valuable space below the sidewalk is rid of the cumbersome caissons, whose place is taken by the comparatively slight bulk of the columns. It is the belief of Mr. Trowbridge that ultimately, in the reconstruction of the city, whole blocks will be syndicated, and a continuous cofferdam wall will be run around each block. This will result in a great saving in foundation work, the columns springing, as in the Bankers' Trust Building, directly from bed rock, while the heavy interior partition walls which now separate the various buildings on a given block will be unnecessary, and light partition walls will take their place.

It can readily be seen that should a whole section of the city be thus founded, the space below the streets, between caisson walls of opposite blocks, would form an admirable three or four story subway in which to place city traction lines, and carry the gas and water mains and the electric cables for light and power purposes.

By embodying in the horizontal framing steel girders of sufficient depth and section, the bending stresses due to wind pressure have been provided for. Moreover, the inertia of the great mass of the building, whose total weight is approximately 45,000 tons, will absorb the shock of the heavier gusts of a thunder storm or tornado.

The interior finish of the building is thoroughly fireproof. No wood whatever has been used. The doors are of steel, and the trim, window sashes, etc., are also of metal. Granolithic floors with marble base-boards, have been laid throughout. Wire-plate glass has been used everywhere in interior partitions. In the basement are powerful fire pumps, and large tanks have been installed in the roof. The use of the pyramidal roof structure entirely for storage purposes is a novel feature. It is reached by elevator, and each of its seven floors is provided with an interior gallery, from which burglar-proof doors open into the several storage rooms thus provided. It is a curious fact that, although lower Manhattan is so abundantly provided with safe-deposit vaults, there is not a single storage warehouse in which bulky materials, such as office furniture, can be placed for safe keeping.

The total cost of the building is about $4,000,000, Its location in the very heart of the Wall Street district, and its advantages of light and outlook, have combined to raise its rental to the highest figure yet recorded for commercial buildings of this type.

An American "Comptes Rendus"

THE *Comptes Rendus Hebdomadaires*—the pink-covered weekly organ of the French Academy of Sciences, so familiar to every scientific man—is an epitome of the progress of science in France. Its cardinal virtue is conciseness. A *savant* will spend years in elaborating some epoch-making discovery—and announce the same in a laconic page or two, confident that his announcement will presently be read in every corner of the world.

Although in America we have no intellectual metropolis in the same sense that France has, yet our political capital—the seat of the great scientific departments of the government, and of the Smithsonian and Carnegie institutions—holds a somewhat analogous position. It therefore appears fitting that the Washington Academy of Sciences—the focus of the scientific community at the capital—has undertaken to publish what promises to be a sort of American *Comptes Rendus*. This publication, the *Journal of the Washington Academy of Sciences*, will appear semi-monthly, beginning July 15th, 1911, and will replace the *Proceedings* of the same academy, than which it will have a far wider scope.

In the new publication will be recorded the results of all kinds of scientific work carried on by the Government, as well as by non-official institutions and individuals at Washington, or connected with the scientific organizations of that city. Each scientific bureau of the Government has been asked to designate some one who will forward to the editors such material as the bureaus are willing to have published in this way. This material may take the form of preliminary statements concerning work nearing completion, abstracts (preferably by the authors) of papers recently published by the bureaus, or complete short articles. The journal will also contain notes of events connected with the scientific life of Washington.

The editors responsible for the successful inauguration of this new enterprise—which is viewed with deep interest by scientific men, in and out of the capital—are G. K. Burgess, of the Bureau of Standards, B. W. Evermann, of the Bureau of Fisheries, and F. L. Ransome, of the Geological Survey.

The principal function of the new journal will undoubtedly be to place before the world, in a concise and easily accessible form, the cream of the information now consigned to a host of official publications, most of which fail to reach a majority of the readers who would find them of interest.

Asteroid Notes for the Month of July

OF the asteroids, Vesta is too near the Sun to be seen during the month of July. Below we give the ephemeris for Pallas, Ceres and Juno. Several have written that they have succeeded in finding one or more of the small planets by the aid of the ephemeris given heretofore. Usually a really good pair of field glasses or a small telescope is all that is needed. For one who has not as yet succeeded in finding one of these, our small neighbors, we suggest that a good pair of field glasses be used and an asteroid selected that is of good magnitude and favorably located. Possibly Ceres will be as good as any for the month of July. It is under the ninth magnitude, constantly growing brighter, and very close to Zeta Tauri on July 15th about 2 A. M. At this time the R. A. of Ceres is 5 hours 32 minutes, and its Dec. is +22° 18′. The R. A. of Zeta Tauri is 5 hours 32 minutes, and its Dec. is +21° 6′. So Ceres will be one degree directly north of Zeta Tauri at this time.

Pallas should be easily found. During the last days of June it moves directly north of Delta Ceti, and by July 1st forms a small triangle with Delta and Gamma Ceti. By the close of the month it passes just to the north of 91 and 95 Ceti. Pallas is also in the morning sky during July.

Juno is still growing fainter—of the 10.5 magnitude on July 11th. However, it is so near Delta Virginis on July 4th that it should be easily seen in even a moderate sized telescope. It will be remembered that on April 28th it was very close to this same star. (See ephemeris and notes in SCIENTIFIC AMERICAN for April 1st.) The R. A. of Delta Virginis is 12 hours 51 minutes, and its Dec. 3° 52′ N. On July 4th the R. A. of Juno will be 12 hours 51 minutes, and its Dec. 3° 41′. In other words, it will be about a sixth of a degree south of Delta Virginis. On April 28th it was one-tenth of a degree due north of it. It is interesting to note its course during these last months. Note the ephemeris for April and follow its motion on the star atlas. It continued to move south till June 1st, when it was stationary, with an R. A. of 12 hours 41 minutes and a Dec. of N. 5° 10′. It is now retracing its steps exactly.

CERES.

Date.	Mag.	R. A.	Dec.
July 3	8.87	5 hr. 12.4 min.	21° 39′
July 11	..	5 " 26.5 "	22° 7′
July 19	..	5 " 40.5 "	22° 30′
July 27	8.76	5 " 54.5 "	22° 49′

PALLAS.

Date.	Mag.	R. A.	Dec.
July 3	9.16	2 hr. 41.8 min.	N. 0° 19′
July 11	..	2 " 53.8 "	S. 0° 7′
July 19	..	3 " 4.5 "	S. 0° 43′
July 27	8.85	3 " 15.4 "	1° 30′

JUNO.

Date.	Mag.	R. A.	Dec.
July 3	10.41	12 hr. 50.8 min.	N. 3° 46′
July 11	..	12 " 55.6 "	3° 10′
July 19	..	13 " 1.1 "	2° 29′
July 27	10.67	13 " 7.4 "	1° 45′

Title Pages for the Scientific American

THE present number of the SCIENTIFIC AMERICAN marks the beginning of a new volume. Contrary to our practice in former years, we have not included the usual volume title page. Those of our readers who wish to bind up the last volume will receive a title page on application to this office.

The Current Supplement

THE opening article of the current SUPPLEMENT, No. 1852, deals with the new Campanile at Venice. —Dr. L. A. Bauer describes some of the problems of ocean magnetic work.—A remarkable paper was recently read by Major George D. Squier before the American Institute of Electrical Engineers, on "Multiplex Telegraphy and Telephony by Means of Electric Waves Guided by Wires." This paper is published.—The fourth installment of Sir J. J. Thomson's brilliant Royal Institution lectures on "Radiant Energy and Matter" finds a place in the current SUPPLEMENT.—Other articles of interest are the following: "The Principles of Original Research," by Prof. Sedgwick Minot; "The Sun's Distance," by Prof. J. H. Ogburn; "An Important Report on Sewage Disposal Investigations"; "Some Recent Types of Aeroplanes"; "Some Recent New Inventions"; "Chemical Research and Industrial Progress;" and "A New Spectroscope and Spectrograph."

Cork Varnish for Ships

IN order to protect the interior of ships from the humidity caused by condensation upon the metallic walls during sudden changes of temperature, the Italian marine has experimented with a kind of hygroscopic varnish, or coating, the essential compound of which is ground cork, which is consolidated by pressure with copal and litharge, and applied to the walls. It has been found that the cork varnish absorbs the watery vapor of the atmosphere to the extent of eight or nine grammes for every square meter of surface exposed.

A Gasoline Tool Car for Railways

THE Chicago and Rock Island Railroad is using a gasoline car to convey men and tools to any point where repairs or construction work are needed. The car not only transports tools and men, but supplies the necessary power for operating electric tools. A 30 horse-power, 4-cylinder, 4-cycle gasoline engine drives a generator which supplies power for operating electric tools. These tools are: Two electric spike screwing machines, six electric drills, one electric saw for rails, and portable emery wheels. The car can carry 8 to 10 men and any reasonable equipment of tools.

The New White Star Liner "Olympic"

A Ship 882½ Feet Long, That Weighs When Fully Loaded 66,000 Tons

THE arrival of the White Star liner "Olympic" at New York sets another mark in the growth of the modern ocean liner toward the ship one thousand feet long. The story of the development of the trans-Atlantic liner is full of interest, and it is worthy of note that until of late years, the growth in size and speed, if we except the case of the "Great Eastern," has been by regular and fairly even advances. Thus the "Britannia," of 1840, 207 feet long, had an average speed of 8.5 knots per hour. The "Asia," of 1850, 266 feet long, and of 12.5-knot speed, had a gross tonnage of 2,226. The "Scotia," of 1862, 379 feet long, and of 14.4-knot speed, had a gross tonnage of 3,871. The "Bothnia," of 1874, was 420 feet long, had a gross tonnage of 4,556 and a speed of 13.8 knots. The "Servia," of 1881, 515 feet long, was of 7,392 gross tonnage, and her speed was 16.7 knots. The "Ivernia," one of the type of mixed cargo and passenger ships of moderate speed, which have now become so popular, launched in 1900, was 580 feet long, had 14,027 gross tonnage, and a moderate speed of 15.25 knots. The "Campania," 600 feet long, of 12,952 tons gross tonnage, with a speed of 22 knots, launched in 1893, was the first vessel to reach a length of 600 feet between the perpendiculars. The "Coronia," launched in 1905, was 650 feet long, with a displacement of 20,000 tons. The first ship to exceed a length of 700 feet was the White Star liner "Oceanic," whose length on deck was 704 feet. Then followed the "Lusitania" and "Mauretania," 790 feet in length, of 33,000 gross tonnage, with respective sea speeds of 25½ and 26 knots per hour, both of which ships made their appearance about 1907. And now, in the "Olympic" and the sister ship "Titanic," we have the first vessels to exceed a length of 800 feet, reaching, indeed, almost to the 900 feet length, while their gross tonnage has gone up to 45,324, and their displacement at maximum draft has reached 66,000 tons.

Although the "Olympic" is not so fast a vessel as the "Mauretania," she is capable, when pushed, of a speed of 22 knots, and, like those vessels, she is, to all intents and purposes, a purely high-class passenger ship. Although it is possible to stow in her hold about 6,000 tons of freight, it is rarely that she will carry more than about 2,000 tons, for her time in port will be almost entirely given up to coaling and getting ready the accommodations for her complement of over 3,000 souls, and caring for the engines and boilers necessary to enable her to develop her maximum horse-power of 50,000.

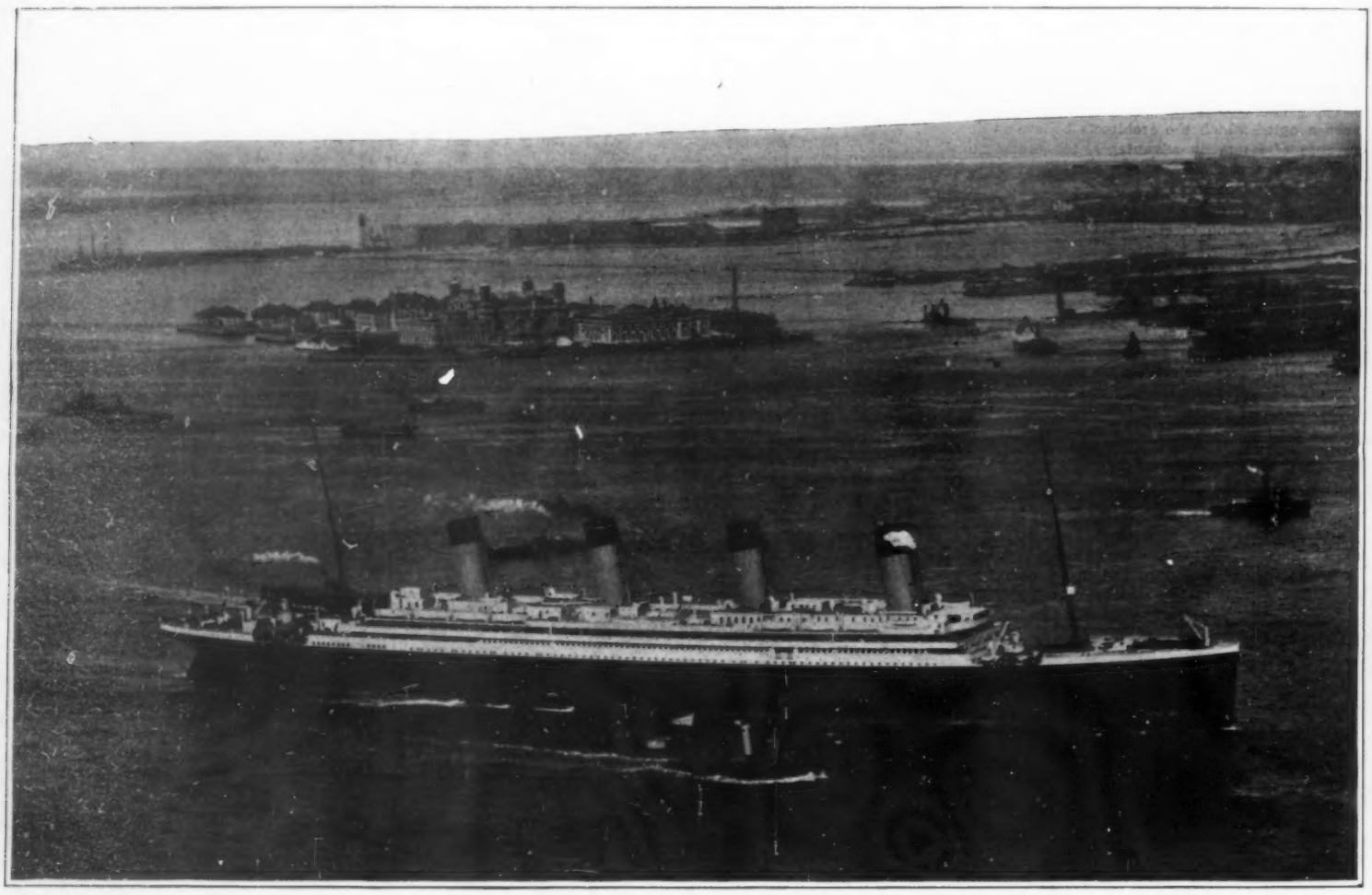
On this, her maiden voyage, she left Southampton at noon on Wednesday, June 14th, called at Cherbourg and Queenstown, and left Queenstown on Thursday. She was at her dock early on Wednesday morning, having completed the trip from Southampton at an average speed of 21.17 knots. As she stead majestically up the North River, and warped in alongside of her pier, the "Olympic" looked every inch of her length and height, and fully came up to the expectations which had been raised by the published description of her vast dimensions. What these are may be gathered from the following figures: Length on deck, 882½ feet; breadth, 92½ feet; breadth over boat deck, 94 feet; height from keel to boat deck, 97 feet 4 inches. At a draft of 32 feet, which the vessel drew on entering the harbor, the height of the boat deck above the water line is 62 feet 4 inches. The height from the keel to the roof of the captain's house is 105 feet 7 inches, and from the keel to the top of the funnels, 24 feet in diameter, 175 feet. Including the floor of the ship at the double bottom, the vessel has 11 steel decks, and her molded depth, that is, the depth to which the solid steel plating of the hull is carried up and broken, is nearly 70 feet, or fully one deck deeper than that of any previous ship. Her gross registered tonnage is 45,324, and her net tonnage 20,894. When the ship is fully loaded to her maximum possible draft, she will displace, or weigh, 66,000 tons.

Now, in view of the fact that the "Olympic" exceeds the "Mauretania" by only 92 feet in length and by 4½ feet in breadth, the fact that her displacement is nearly 50 per cent greater, or 66,000 tons against 45,000, needs some explanation. The greater displacement is due to the fact that the model of the "Olympic" is very much fuller, her sides for several hundred feet amidships being practically parallel—the hull, indeed, consisting of a long, parallel body, with a rather fine entrance and delivery. This form is admissible in a vessel of 21 to 22-knots speed; but when we come to vessels driven at from 25 to 26 knots, as are the "Lusitania" and the "Mauretania," fineness of form becomes a prime consideration. It is a fact that there is scarcely a straight line to be found in the underwater body of the two Cunard liners. This fining down of the hull reduces the displacement, and hence the wide difference in the figures for the White Star and the Cunard vessels.

The maximum horse-power of the "Olympic" is 50,000; that of the "Mauretania," 80,000. This disparity in horse-power is perfectly in keeping with what we have said regarding the form of hull, displacement, and speed of the two ships. High speed, after 21 knots has been passed, is obtained only by a large addition to the horse-power, which, for the same vessel, increases as the cube of the speed. Hence, in spite of the finer lines of the "Mauretania," it takes 80,000 horse-power to drive her 45,325 tons of weight through the water at 26 knots, as against 50,000 horse-power to drive the 66,000 tons of the "Olympic" at 21 knots. As a matter of fact, the speeds quoted could be obtained only on smaller draft and lighter displacement, say about 40,000 tons for the "Mauretania" and 58,000 tons for the "Olympic."

The weights of various parts of the "Olympic" necessarily run to large figures. The largest plates on the hull weigh 4½ tons; the rudder weighs 100 tons; the anchors, 15½ tons each; the center propeller, driven by the turbine engine, weighs 22 tons, and the two wing propellers, driven by reciprocating engines, weigh 38 tons each. The weight of each link in the anchor chain is 175 pounds.

The engine room plant of the "Olympic" embodies the latest ideas in marine engineering. Steam from the boilers is expanded down through the higher ranges of pressure in two reciprocating engines, each driving its own propeller. From the reciprocating engines the steam is led to a large low-pressure turbine, which drives directly a central propeller. This combination secures a more economical use of the steam than is possible with an all-turbine plant. Moreover, it per-



Length, 882 1/2 feet ; beam, 92 1/2 feet ; molded depth, 70 feet ; displacement on maximum depth, 66,000 tons ; horse-power, 50,000 ; maximum speed, 22 knots ; passengers and crew, 3,200.

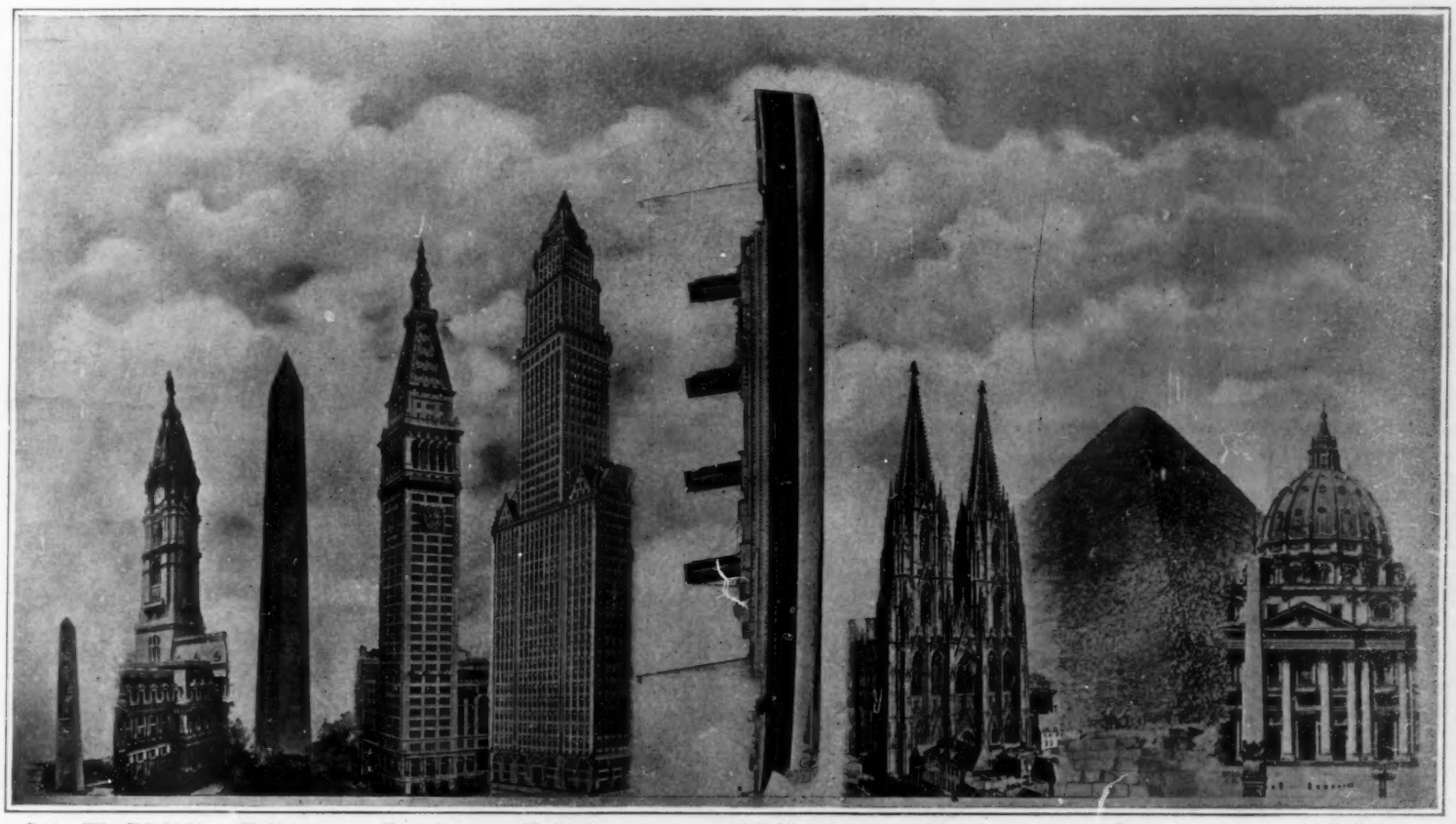
ARRIVAL OF THE WHITE STAR LINER "OLYMPIC" AT NEW YORK

mits the several propellers to be driven more nearly at their best economical speed. It is known that the "Mauretania" consumes about 1,000 tons of coal per day; it is not probable that the "Olympic" will burn over 700 tons per day, if, indeed, she does not come below that figure.

Naturally, a ship of this great size has accommodations for a small townful of people (3,356, as a matter of fact), of whom 750 are accommodated in the first class, 550 in the second, and 1,200 in the third; while the balance is made up of 63 officers and sailors, 322 engineers and firemen, oilers, etc., and 471 stewards, waiters and other members of the commissary department.

An interesting structural feature in the ship is the special provision which has been made for strengthening her long hull to resist the heavy bending stresses to which it will be subjected when driving into a heavy sea and riding over the waves. Some years ago, in our issue of November 10th, 1900, we made a study of some of the possible features which would be incorporated in the future four-day liner, should such a 30-knot ship ever make its appearance. We found that, to give a ship of the great length required sufficient longitudinal strength, it would be necessary to run a plate girder or bulkhead through the center of the ship for several hundred feet amidship, with extra thickness of plating at the top and bottom of this girder, and also at the top and bottom of the shell plating of the vessel. It is interesting to note that the "Olympic" has been strengthened by running four longitudinal girders through the ship for this same purpose, girders extending from the keel up through several decks.

Although we are mainly concerned with the technical features of the "Olympic," this article would be incomplete without some reference to the unusual accommodations provided for the comfort and entertainment of the passengers. In the first place, the deck accommodations are superb, the boat deck, between 60 and 70 feet above the water, being singularly free from ventilators, deck engines and similar obstructions. The bridge deck promenade alone is 550 feet long, and other promenade accommodations through the ship are in proportion. The main dining saloon, which extends the full width of the ship, is over 90 feet wide by 114 feet in length, and it can seat 532 people. Beyond, and really forming a part of it, is a spacious lounge where passengers may assemble before entering the dining room. A notable feature in this room is the size of the windows, each of which is lighted by two large port holes, one above the other, the light being softened by passing through leaded windows. The main lounge, finished in light oak, is a superb room in the Louis XV. style, measuring 63 by 59 feet; and rivaling it in its proportions and magnificence, is a smoking room of equal size. A notable feature in these rooms is the use of large bay windows, filled with leaded glass, which strongly accentuates the effect which they produce of being large apartments in some stately manor house of the older countries. A swimming pool 32 feet long, a racquet court 30 feet long, and a very complete gymnasium, are among the features provided for the recreation of the passengers. Lastly, mention should be made of the 69 separate suites of apartments, decorated in the Empire, Louis XV., Georgian, Queen Anne, and Dutch styles, which are available for the use of those passengers who are willing to pay from $1,250 to $2,250 for the privilege of occupancy.



Bunker Hill Shaft. Philadelphia City Hall. Washington Monument. Metropolitan Tower. Woolworth Building. S. S. Olympic, 882½ Feet. Cologne Cathedral. The Great Pyramid. St. Paul's, London.

COMPARISON OF THE "OLYMPIC," 882½ FEET IN LENGTH, WITH SOME TALL BUILDINGS OF THE WORLD

An Important Contribution to the Nitrogen Problem

IN many soils the amount of nitrogen present is the factor that limits the size of the crop of grains, potatoes and other non-leguminous plants. Not only is the size of the crop limited; the plants growing on such soils have a lower percentage of protein than the same kinds of plants grown on soils with an abundance of nitrogen in suitable combinations.

Experiments conducted during the past few years at the Cornell University Agricultural Experiment Station by T. L. Lyon and James A. Bizzell have shown that in addition to restoring to the soil a quantity of nitrogen compounds, which are later available for other crops, the growth of legumes may also furnish nitrogenous food to other plants growing with them, and then influence the nitrification of the soil besides.

The following table combines the results of several experiments:

TABLE SHOWING THE PERCENTAGE OF PROTEIN IN GRAIN CROPS GROWN ALONE AND WITH LEGUMES.

Grain grown alone (Grain crop)	Percentage of protein	Grain grown with legume (Legume)	
Timothy	12.75	15.56	Alfalfa
Timothy	9.00	9.69	Alfalfa
Timothy	17.19	24.56	Red clover
Oats	12.69	13.44	Peas
Oats	14.94	16.19	Peas
Oats	10.50	14.06	Peas

In earlier experiments the yield of the soil that had borne one or more crops of legumes was compared with soil upon which plants of this family had never been grown before. In the present experiments the two kinds of plants were sown together. A comparison of the total yield is shown in the next table, wherein are compared the pounds of hay per acre when oats was grown alone with the yield of hay when oats was grown with peas, on two different soils:

POUNDS OF HAY PER ACRE.

Oats alone	Oats and Peas
3,750	4,850
2,900	3,900

Other tables in the original paper show the total proteins per ton of yield to be likewise in favor of the grain raised in combination with the legume. The increased protein content of the hay makes it of greater food value.

On certain plots alfalfa was grown for five years; on others with the same kinds of soils, timothy was grown for five years. At the end of this time there was found a larger percentage of nitrates in the alfalfa soil than in the timothy soil, as was to have been expected. But on similar plots which were kept bare for a season after the removal of the plants the same differences were observed. This suggested that nitrification continues after the removal of the alfalfa, and actual experiments with samples of soils in flasks showed that such is really the case. The rate of nitrification, or of converting ammonia into nitrates, is of great importance in agriculture, since it determines the amount of nitrate that will be available for the crop. Samples of soil were tested for the nitrates present; weighed quantities of ammonium sulphate were added and the nitrate test again repeated after ten days. In every case the soil that had borne alfalfa showed greater nitrification than soil that had not borne a leguminous crop. At the end of twenty days all of the ammonia had been nitrified in all of the soils. In other words, the rate of nitrification is decidedly influenced by the fact that alfalfa had been grown on the soil.

The effect of liming upon soils with and without legumes was also studied, and the advantage of liming shown to lie in the influence it has upon the rate of nitrification.

The Largest Radiator in the World

HIGH-POWERED motors require large radiators, and Consul General T. St. John Gaffney of Dresden describes what is termed the largest radiator in the world. It is intended for the 300 horse-power motor of an airship, is made of aluminium, is 4 feet 7 inches high, 4 feet 7 inches broad and 8 inches deep. Its economy of operation is indicated by an hourly capacity of 6,868 gallons and a radiation of not less than 288,000 calories per hour, while 1,695,000 cubic feet of air pass through it. Its weight is: Empty, 145 pounds, and 209 pounds when full of water.

The Heavens in July

Motions of Stars in Corona Borealis; Two Remarkable Double Stars; the Planets in July

By Henry Norris Russell, Ph.D.

CORONA Borealis—the Northern Crown—though not one of the brightest constellations is conspicuous enough to deserve inclusion in our list of initial illustrations. It is very easy to recognize. The semicircle of seven stars, on the line joining Arcturus and Vega, and nearer the former, cannot be mistaken for any other configuration, and stands out among the neighboring stars clearly enough to convince us that this is a natural constellation—if we may so speak—and not merely a group with arbitrarily assigned boundaries.

It has also the somewhat unusual distinction of bearing some resemblance to the object for which it is named. Though much less complete than the wreath of oak-leaves which our initial represents, its form certainly suggests a wreath or crown of some sort.

The first really astronomical question which a look at this group suggests is: Are these stars really near each other—comparatively speaking—and arranged along a semicircle, or is their apparently symmetrical grouping merely an effect of chance?

That the latter alternative is the true one is shown by a study of their proper motions—that is, of the motions, apparently slow but really rapid, which the stars themselves possess in space.

No two of the seven stars composing the circlet are moving in the same direction, or at the same rate. The two brightest, Alpha and Beta Coronae, are moving in opposite directions and have nearly exchanged places in the past fifty thousand years (which is a short time in the history of a star). At an equal interval hence, they will be apparently three times as far apart as they are now; and some of the other stars will also have moved so far that the group will bear no resemblance at all to its present aspect.

It may seem a bold prophecy to predict at all what a constellation will look like after so long a time; but the change in a star's position which would be necessary to alter the appearance of the group to the naked eye is several thousand times as great as the amount which can be detected by accurate measurements with suitable telescopes. We have accurate observations of these stars covering over a century and from these their motions can be determined, and their positions predicted, even a thousand centuries hence, more accurately than naked-eye estimates could determine them then.

Some of the individual stars of the group deserve mention. Their real brightness, and their distances from us, presumably vary as much from star to star as do the directions and rates of their proper motion. For only one of the brighter stars do we have any trustworthy determination of these quantities—the brightest of all, sometimes called *Gemma*, which belongs to the group of stars which also includes Sirius and several of the brightest objects in Ursa Major (a description of which was given in our issue of April 2nd, 1910). Its distance appears to be about seventy-eight years, and its actual brightness some sixty times that of our Sun.

There are several interesting double stars which deserve our notice. Two are rapid binaries. One of these, Gamma Coronae, which lies next to *Gemma* on the east, is too close and unequal a pair to be separated by any but powerful telescopes. The other, Eta Coronae, may be found by drawing a line from *Gemma* through the next star to the westward, and carrying it on about two-thirds as far again. This fine and nearby equal pair is now at its greatest separation (about 1 second), and can be seen double with five inches or more of aperture. The period is 41½ years, and three revolutions have been completed since the first observation by Herschel in 1781.

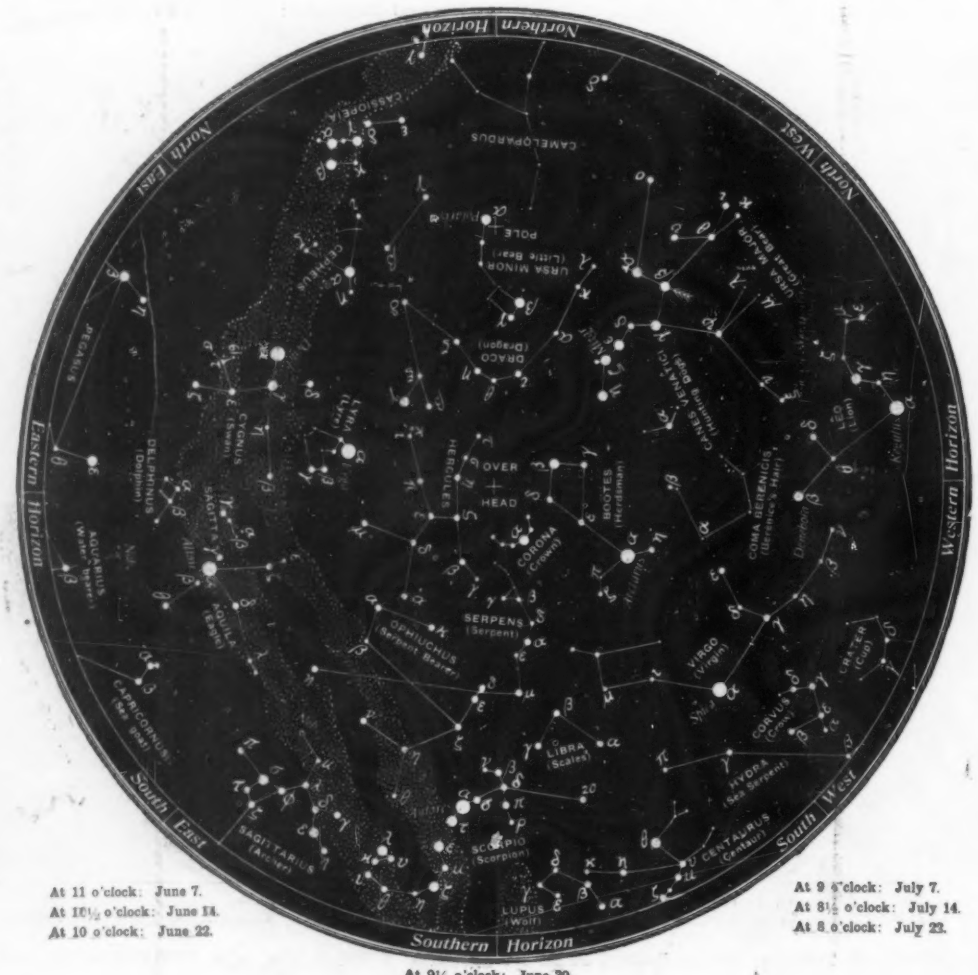
Observers with smaller instruments will find objects of interest in ν and σ Coronae—two small stars, not shown on the map, but easily picked up near the intersection of lines drawn from δ through ζ Herculis, and from η Herculis to α Coronae.

Sigma Coronae, the westernmost of the two, is a binary of long period—350 years or more. The components, of the 5th and 6th magnitudes, are now 5 seconds apart, and can be separated by a small telescope.

Nu Coronae, the eastern of the two, is a very wide double, separable even by the naked eye, and widely divided by a field-glass. The two components are moving in opposite directions, and their apparent proximity is only accidental.

West of Corona (which at the time for which our map is drawn is nearly overhead) is Boötes, marked by the splendid orange star Arcturus. Below in the southwest is Virgo, with the very bright planet Jupiter outshining all her stars. Leo is low in the west, and Ursa Major well down in the northwest.

Ursa Minor and Draco are between the pole and the zenith. Cassiopeia and Cepheus are low in the northeast. Cygnus and Aquila occupy the Milky Way in the east, with Lyra above them, and Hercules still higher up. Capricornus is rising in the southeast, and Sagittarius farther to the southward. Scorpio shows splendidly in the southern sky, the whole curve of his tail being well visible, and Ophiuchus and Serpens are above.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

NIGHT SKY: JUNE AND JULY

THE PLANETS.

Mercury is in conjunction with the Sun on the 3rd, and is invisible, except perhaps at the end of the month, when he sets about 8:15 P. M. and may be seen as an evening star. On the 29th he is close to the bright star Regulus, but both are low in the twilight. Venus is evening star in Leo and reaches her greatest elongation (or apparent distance from the Sun) on the 6th. She remains in sight until nearly 10 P. M. on the 1st, but, being farther south and nearer the Sun, sets about 9 o'clock at the end of the month. She appears telescopically as a half moon at the beginning of the month and as a wide crescent at its close, and to the naked eye is near her greatest brilliancy.

Mars is in Aries, rising about midnight in the middle of the month. He is slowly moving eastward toward Saturn, and overtakes him in August.

Jupiter is in Virgo and adorns the evening sky. He is in quadrature with the Sun on the 29th, and is due south at 6 P. M.

Saturn is in Aries, a little east of Mars, and rises about an hour later.

Uranus is in opposition on the 20th, on which date he is in R. A. 19 h. 58 m. 21 s., declination 21° 14′ 37″ south, and is moving 10 s. west and 28″ south per day. These data will enable those provided with setting circles on their telescopes to find him at once. Otherwise we may proceed as follows. A line from γ Sagittarii through a point half way between ζ and σ in the same constellation, carried as far again, points out a group of four small stars. Uranus is just half way between these and β Capricorni, in a very barren region. He appears as a star of the sixth magnitude, barely visible to the naked eye.

Neptune is in conjunction with the Sun on the 14th and is invisible throughout the month.

The Moon is nearest us on the 24th and farthest away on the 8th. She is in her first quarter at 4 A. M. on the 3rd, full at 7 A. M. on the 11th, in her last quarter at midnight on the 18th, and new at 3 P. M. on the 25th. Since new Moon comes so near perigee we may expect unusually high tides about this time, and also unusually low tides, the range of the tide being increased, but the average level of the sea remaining unchanged.

In her circuit of the heavens our satellite comes nearly in line with Jupiter on the 5th. Uranus on the 12th, Mars on the 19th, Saturn on the 20th, Neptune on the 24th, Mercury on the 27th, and Venus on the 28th. The conjunction with Jupiter is fairly close, but takes place after the Moon has set upon our part of the world.

Princeton University Observatory.

Peruvian Petroleum

EFFORTS are being made to develop more extensively the petroleum resources of Peru. The known deposits of oil occur in a very narrow strip of land between the foothills of the Andes and the shore of the Pacific, and much of this is flooded at high tide. Piles of railroad iron driven in the pure ocean sand, which varies in depth from 5 to 50 feet, are used as foundations for the derricks. The shallowest of the driven wells is 1,760 feet in depth. There is very little gas, and the oil is very heavy, so that it can be put into buckets with shovels, and it is carried direct to the furnaces to serve as fuel.

Curiosities of Science and Invention

Automobile Bridges in California

EXCEPT for a few streams which become flooded, and therefore impassable, during the rainy season, conditions in California are ideal for touring the year around. But until the Automobile Club of Southern California began its active agitation in the matter of good roads there was no effort to bridge these streams, and whole sections of the country were at times completely closed off from the rest of the world, the fords being impassable from floods and quicksands. Particularly was this the case in San Diego County at the crossing of the San Mateo and Santa Margarita rivers; and as visiting motorists in California all desired to go to San Diego by automobile, some means of transportation across these washes had to be devised. They had to be temporary, not only because of the expense of permanent bridges, but also because the club expected to succeed in its efforts to have permanent bridges built by the county. Accordingly, the club engineer devised the automobile bridge shown in the illustration. It is built of channel-iron 10 inches wide and 6 inches deep, braced together with iron strips, giving a spread of 56 inches over all, thus allowing the use of 6-inch tires and taking care of the average car.

The approaches to the bridge were built of wood, and the channel-iron troughs were raised upon concrete piers. One of these bridges was 84 feet long, not counting the approaches, and the other measured about 52 feet.

Auto bridge over the Santa Margarita, California.

Odd method of launching a boat in China.

"Queen of the Forest."

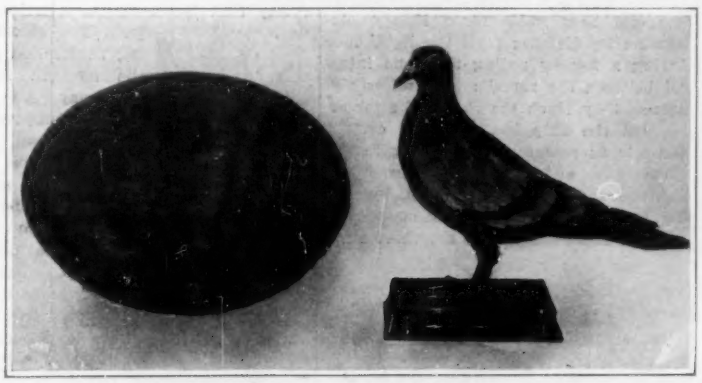
"Monarch," a 90-foot fir.

The "stone forest" of California.

The Largest Egg in the World

AN egg of the gigantic extinct bird aepyornis of South Madagascar is on exhibition at the Museum of Natural History, New York. The enormous size of the egg may be gleaned from the accompanying photographs. In one illustration a full grown pigeon is shown standing beside the huge egg, and in the other picture on the right is seen an ordinary hen egg; on the left is the egg of an ostrich. The aepyornis egg has a capacity of two gallons, or 150 times that of a hen's egg. The shell is ⅛ inch thick. Lengthwise it is 32 inches in circumference and it measures 26 inches around the middle. Though termed a fossil egg it is not petrified, but is in perfect condition, unbroken, and has a yellow color. The contents have turned into a fine dust which comes out, when handled, through a small natural perforation on one side. The aepyornis, like the moa of New Zealand, was exterminated by the hand of man. A few centuries ago it was quite abundant. Several incomplete fossil remains have been discovered, but no complete skeleton has ever yet been found. These show the bird was three-toed, of massive proportions and short winged. The Madagascar natives have for many years used the great egg shell for various household purposes. In fact, the first knowledge of these eggs became known when some Madagascar natives came to the Mauritius to buy rum, bringing the Aepyornis eggs with them to hold the liquor. Only three or four of these huge eggs have been brought into civilization. The present one is the most perfect as well as the largest known.

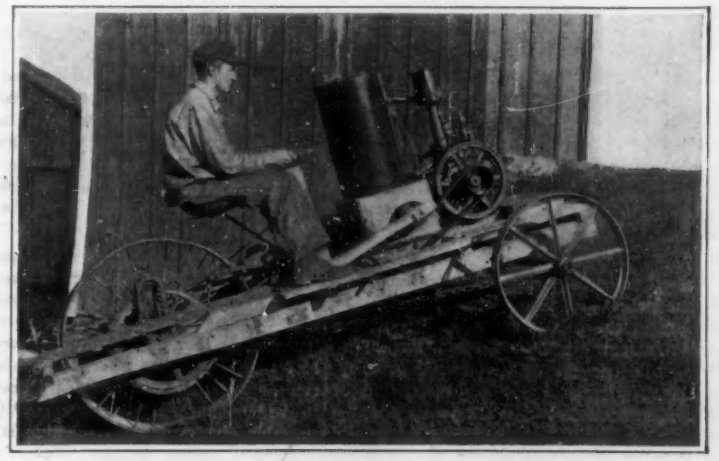
Relative size of ostrich, aepyornis, and hen eggs.



Aepyornis egg compared with a pigeon.

Launching a Boat in China

THE accompanying picture of a motor boat shows the ingenious method that the Chinese have for launching. The keel of the boat was laid on cross beams several feet above ground so that the planking could be easily put on. When it was ready for launching the pier shown in the picture was constructed of bamboo tied together and to the supporting posts by bamboo splits. Then bags made of coarse grass were filled with sand and stacked under the boat. The cross beams and other supports were knocked away, and then four men, two on each side of the boat, cut open the bags and as the sand poured out the boat settled slowly and comfortably down upon the pier. The boards underneath the three large cross beams were greased with coarse beef fat, and a half dozen men, by means of block and tackle, easily hauled it down the pier, where it was readily floated when the tide rose. Some of the bags of sand may be seen in the picture under the boat where it rests waiting for the incoming tide. By extending the pier the boat could have been launched directly into the water.



Home-made gasoline traction truck.

The "Stone Forest" of California

CALIFORNIA, among many other natural wonders, contains a "Stone Forest." This is located in Sonoma County, only a few miles from the little resort of Calistoga Springs. This "forest" consists of a great many petrified trees—all of which are prostrate.

In respect to the great number of petrified trees, and their immense size, the California "stone forest" surpasses that of Arizona. Strange to say, but very little is known about these wonderful Sonoma County petrifactions—so far as the general public is concerned. Many of these trees are of enormous size. The famous "Queen of the Forest" is a prehistoric redwood, about 80 feet long, and nearly 12 feet in diameter. It has been broken in several places, and these breaks are as clean as if cut off with a saw. A tree has grown up through one of the breaks and has attained quite a large size. Another giant tree known as the "Monarch" lies near by, which is almost 90 feet long and is without a break. This tree is a fir, and averages 10 feet in diameter. Not far away is another giant son of the forest—a redwood that is about 60 feet long and 9 feet in diameter. This tree is broken into many hundreds of pieces, yet it retains its shape almost perfectly. Scattered about for the area of several acres, are many other pieces of petrifaction. So perfect has been the transmutation into stone, that the grain of the wood still remains very clear, and the variety of the tree may be easily determined.

Home-made Gasoline Traction Truck

THE accompanying illustration shows an interesting home made traction truck designed at Shiloh, Ohio, and utilized for sawing wood, grinding feed and pumping water. It is equipped with a 2½ horse-power two cycle gasoline motor provided with a throttling governor and weighs only about 200 pounds. It was built for portable power service, the equipment being arranged for moving the engine by its own power from place to place.

For pumping water the power is supplied by a pitman head on the rear of the truck, the pump being operated by a part of the same gearing that is used for driving the machine. The propelling chain is disconnected by a clutch when the engine of the tractor is used for pumping or similar service. The designer, A. E. Cross, is adding a rotary force pump mounted on the machine to be used for spraying trees and washing buggies. An equipment is also being provided for operating a power sheep-shearing rig, so that a great variety of work can be accomplished by this unique outfit.

As may be observed in the accompanying engraving, the truck is fairly powerful for its weight and capable of climbing rough and steep grades.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

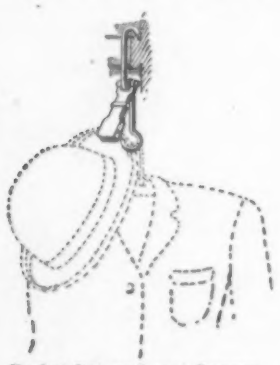
Oddities in Invention

Potato Pick-up.—An ingenious device for picking up potatoes which have been harvested by digging with the machine or by hand is shown in the accompanying engraving. It consists of a scoop attached to a handle and provided with a rake adapted to draw the potatoes into the scoop. The scoop comprises a mouthpiece and a basket. It is attached to the handle by means of a pair of links, and the rake is attached to the scoop by

Potato pick-up.

means of two links. When the device is supported by the handle it assumes the position shown by full lines in the drawing, but on pressing the handle forward the weight of the scoop is supported by the ground and the parts take the position shown by dotted lines in the drawing, from which it may be seen that the potatoes are drawn by the rake up the mouthpiece and into the basket.

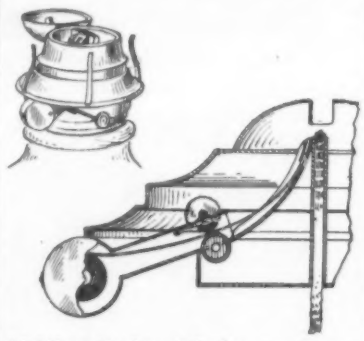
Pocket Hat and Coat Hanger.—For the use of travelers and for those who may find it necessary to hang up a hat and coat in a place not provided with a fixed rack, a simple pocket device has been invented. This may be secured to the molding of a door or to any projecting part. The device consists of a prong bent over and provided with a pointed



Pocket hat and coat hanger.

end whereby the device may be attached to a support. Extending from the prong is a hook on which the coat may be hung. This hook is made in the form of a button hook, so that it may be used for buttoning shoes if desired. To hold the hat, a clasp hanger is provided consisting of a pair of spring arms which may be closed on the rim of a hat and be held by a loop or like retainer. When not in use the device may be folded into a small compass and carried in the vest pocket.

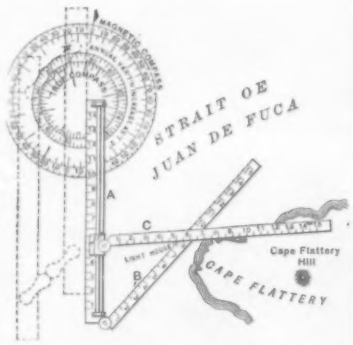
Lamp Igniter.—The lighting of kerosene lamps is usually quite a bother for the reason that the lamp chimney must be removed, and if this is hot it is necessary to wait for it to cool down. In order to facilitate the lighting of the lamps an inventor living in Colorado has devised a scheme by which the ignition may be accomplished by merely turning a thumb screw. An igniting strip is used, in the form of a roll, which is fed from a casing to the wick of the lamp. In the process of feeding the strip to the wick, it is dragged across a roughened surface that ignites the strip so that it is carried aflame to the wick.



Lighting attachment for kerosene lamps.

The accompanying drawing shows the mechanism quite clearly. The igniting strip is provided at intervals with protuberant ignitable heads. The scratching element which ignites these heads by friction bears against the upper surface of the strip immediately over the feed roll. The main body of the strip is incased in a heat-proof compartment so that there is no danger of setting it afire with the heat of the lamp. One of the advantages of this construction is that it may be used in connection with a lantern to ignite the wick in windy places where a match cannot conveniently be used.

Instrument for Determining a Ship's Position in a Fog.—Hertzian waves travel 186,330 miles per second; sound travels 1,123 feet per second in air, at ordinary temperatures, and 4,593 feet per second in sea water. If a lighthouse should send out a sound signal simultaneously with a wireless telegraph signal it would be possible for a ship to determine its distance from the lighthouse during a fog by noting the time interval between the sound and wireless signals as they reach the ship. If after an interval the ship has moved a certain distance as measured by the log in the usual way, and its distance from the lighthouse is determined again, by noting the interval between the sound and wireless signals, we have the three sides



Instrument for determining a ship's position in a fog.

of a triangle, with the lighthouse at one point, and the two positions of the ship at the other two points. A simple instrument has been devised for laying off this triangle on a chart, so as to fix the position of the ship. It consists of a graduated scale *A* with two graduated arms, *B* and *C*, secured thereon, the arm *C* being capable of sliding motion along the scale. The instrument can be set so as to form a triangle with the three sides proportionate with the triangle determined by the signal observations. This may now be laid upon the chart with the graduated scale lying in the direction of the ship's course as indicated at *A*, and the juncture of the two arms *B* and *C* at the lighthouse, when the position of the ship will appear at the junction of arm *C* and the scale *A*.

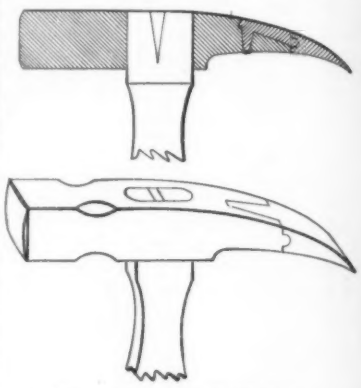
Shoe Button Remover.—A simple device has been invented which may be applied to an ordinary pair of shears to facilitate the removal of shoe buttons. This device, as shown in the accompanying illustration, consists of an extra blade that is forked and slightly bowed. It is attached to the shears by means of a pivot bolt and a pin that serves to make the connection rigid. In use the forked blade is slipped under the button, serving to draw it away from the material so that the blades on the shears are in the right position to sever the threads without danger of cutting the material and with no liability of coming in contact with the metal shank of the button. When it is desired to sharpen the shears the attachment may readily be removed.

Shoe-button remover.

Combined Mop Head and Wringer.—The task of wringing out a mop is so disagreeable that many devices have been invented for performing the operation mechanically. Instead of providing a separate wringer to be used with the mop, an inventor has recently hit upon the idea of constructing the mop in such a way that it constitutes a wringer as well. The accompanying illustration shows the mop in section. As may be seen it is composed of two principal parts, one a central shaft with a collar secured thereon, and the other a sleeve mounted so that it can turn on the shaft. The mop proper consists of yarn looped from the sleeve to the collar in such a way as to form a double walled cylinder. The yarn is applied in a continuous length, being held in place by means of wire which encircles the sleeve in one case, and the collar in the other, being firmly clamped thereto. The mop may be used in the ordinary way, and when it is desired to wring it the sleeve is held in one hand and the handle of the mop is rotated therein, causing the yarn to be twisted and wrung out thoroughly.

Combined wringer and mop.

Improved Bricklayer's Hammer.—That part of the bricklayer's hammer with which the bricks are chipped off, and which is known as the peen of the hammer, is liable to wear out before the rest of the hammer does. For this reason an inventor has devised a hammer in which the peen is made readily removable. The way in which a is done is clearly shown in the illustration, a locking joint being provided between the peen and the hammer which will stand the thrust when the peen is in use. The peen may be made of high carbon steel so that it will wear for a great length of time, while the rest of the tool may



Hammer with detachable peen.

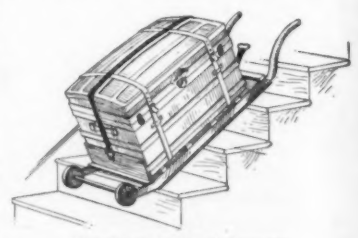
be made of an inexpensive low carbon steel. When the peen wears out it may be detached quickly and replaced with a new peen.

Adjustable File Handle.—The accompanying engraving illustrates a handle for files which is adaptable to files of different sizes and may be readily applied or removed. It holds the file by the tang in such a way as not to project

Adjustable file handle.

below the operating surface of the file. This permits of using the file perfectly flat, which in the majority of cases is of great advantage. The clamp by which the file is attached to the handle consists of two jaws that can be locked and tightened upon the tang of the file by means of a wedge. This in turn is held in place by means of a set screw.

Hand Truck for Stairways.—In order to facilitate the transporting of trunks up and down stairways, as well as upon level surfaces, a hand truck has been provided which in addition to the usual wheels in front, is provided with endless belts at each side which may be



Hand truck for stairways.

used as running surfaces in the manner shown in the illustration. The belts are supported at frequent intervals by rollers and bearing blocks. When moving the trunk up or down a stairway, the wheels clear the steps, but the belts

bear against the nosing of the treads. These belts prevent any possible marring or injury to the woodwork and they may be employed, as well, on level surfaces that are not carpeted if it is desired to prevent marring the floor.

Edison Giant Roll Patents Sustained

AN important decision has just been handed down by Judge Hazel in the United States Circuit Court of the Western District of New York in a suit against the Allis-Chalmers Company and two of its customers, the Empire Limestone Company and the Casparis Company, on Edison patents Nos. 672,616 and 672,617, granted April 23rd, 1901, on the so-called Giant Rolls. These rolls are referred to in the recent book, "Edison: His Life and Inventions, by Frank L. Dyer and T. Commerford Martin":

"No such departure was as radical as that of the method of crushing the ore. Existing machinery for this purpose had been designed on the basis of mining methods then in vogue, by which the rock was thoroughly shattered by means of high explosives and reduced to pieces of one hundred pounds or less. These pieces were then crushed by power directly applied. If a concentrating mill, planned to treat five or six thousand tons per day, were to be operated on this basis the investment in crushers and the supply of power would be enormous, to say nothing of the risk of frequent breakdowns by reason of multiplicity of machinery and parts. From a consideration of these facts, and with his usual tendency to upset traditional observances, Edison conceived the bold idea of constructing gigantic rolls which, by the force of momentum, would be capable of crushing individual rocks of vastly greater size than ever before attempted. . . . He proposed to eliminate the slow and expensive method of breaking large boulders manually and to substitute therefor momentum and kinetic energy applied through the medium of massive machinery which, in a few seconds, would break into small pieces a rock as big as an ordinary cottage piano and weighing as much as six tons. Engineers to whom Edison communicated his ideas were unanimous in declaring the thing an impossibility; that it was like driving two express trains into each other at full speed to crack a great rock placed between them; that no practical machinery could be built to stand the terrific impact and strains. Edison's convictions were strong, however, and he persisted."

Judge Hazel, in referring to the patents under consideration and in setting forth a judicial review of Edison's accomplishment, said:

"Mr. Edison's object was to devise a method by which massive rock or boulder when taken from their bed could be instantaneously crushed or broken into pieces at the least possible expense by the blows of large projections on the rollers and thus to eliminate the hand sledging or blasting of the prior art. To accomplish his object it was necessary that the rollers correspond in weight and strength to the size of the material to be broken up. He believed it possible to use the energy and force generated by the inertia of revolving objects. The problem was how to apply such energy to assist in the crushing operation. Kinetic energy is the term by which such force and power is technically known. The skilled engineer knew that a heavy rotating object contained stored power and energy component with it, and in the adaptation of such force and power for breaking and crushing large rock, it will be comprehended that if such energy could be practically used an achievement of great economic value and benefit in this art would result. It was necessary to design and construct machinery and rollers of a peculiar kind together with facilities for placing and using them in accordance with the *modus operandi* specified in the patents in suit. The patentee surmounted all obstacles and the record shows there were many. He was the first to evolve a crusher by which kinetic energy became a potential factor in the method of crushing and breaking rock by blows from the knobs on rollers. It scarcely can be doubted that his inventions are meritorious and involve in their organization and perfection patentable skill of a high order."

The court then refers to the claims of the two patents, one covering broadly the method involved in crushing rock by kinetic energy and the other relating to the apparatus employing the two massive rolls which are so driven as to permit the crushing and breaking to take place. It was urged in defense of the suit that crushing rolls of much smaller size had been used, generally geared together, and that no invention would be required to increase the size and weight of such rolls and to dispense with the gear so as to permit the rolls to operate independently. Concerning this defense, Judge Hazel said:

"A number of patents for crushers having rollers are claimed by defendants to anticipate and limit the claims in controversy, but such patents are inapplicable. To bring together and adapt in dimensions, iron rollers of such large proportions inclosed in a frame and providing means for periodically storing kinetic energy and periodically expending it as described in the specifications, was invention of the highest merit. It was not simply a question of changing the proportion, size or shape of the rolls. New and novel additions in crushing apparatus were made. The prior crushing or pressing rolls contained no helpful suggestions to the patentee as to the manner of using kinetic energy to instantaneously fracture heavy rock. Although the prior art shows crushing rolls with irregular surfaces, yet such rolls were geared together and were not driven by a belt in opposite directions. They were incapable of delivering blows to powerful rock masses. Indeed there is a total absence in the prior art of the use of kinetic energy to secure the hammering action necessary to break such heavy material as contemplated by Edison's invention. . . . In the prior art there is not disclosed any method or apparatus for breaking rock by the medium of crushing rolls which are provided with knobs or projections and are driven by belting. They were provided in most instances with teeth or projections on the rolls which were geared together and their function was to compress, pinch or pick the material to separate the particles. The driving agent apparently performed the work of crushing the material while in the patents under consideration there is a distinct departure, the material being wholly crushed or broken by the energy of the knobs on the rolls. Although some of the separate elements of the claims in controversy were old and are found in the prior apparatuses, yet such old elements had never before been assembled or combined to use power stored in the rolls to break or crush rock nor prior to the inventions in suit had such rock been broken or crushed by hammer blows from projections on the rolls driven by belt and rotating in opposite direction. . . . It is not enough to select separate elements from different devices and then without making any patentable change or improvement insist, as do the defendants, that the patented structure might have been similiarly constructed. The claims are entitled to such a fair construction as will preserve to the inventor the fruits of his discovery."

The defendants structure was held to be an infringement. On this subject the court said:

"To summarize, the defendants' rolls in operation are substantially the same as those of complainant, having a like capacity for crushing rock; they use the kinetic energy to break the material periodically dumped upon the rolls and their operations perform the functions of the patents in suit and achieve the same result. The method patent describes the mode of treatment of the rock by which it may be shattered and the series of steps to be taken in the transforming process.

"The combination of elements by which the splendid results of breaking rock by blows due to the use of kinetic energy were attained undoubtedly involves the exercise of invention as distinguished from mechanical skill. The prior art neither suggested the patentee's method nor the apparatus by which the work could be done."

How I Invented the Air Brake—III*

By George Westinghouse

THE next event of importance was the application of the brakes in November, 1869, to a longer train of ten cars upon the Pennsylvania Railroad, which was taken to Philadelphia for the purpose of demonstrating to the directors of that railway the success of the apparatus. I may say at this point that the Pennsylvania Railroad had been using for some years a chain brake similar to the one applied by Mr. Ambler, but had found that its use was limited to short trains and that it was not a satisfactory contrivance for the purpose intended. There were invited to witness these trials in Philadelphia a large number of railway people, and the papers gave extended notices of the tests made, which brought to the train on the next day Mr. George L. Dunlop, the general superintendent of the Chicago & Northwestern Railway, who was desirous of having the whole apparatus fully explained to him. The result of this inspection of the air brake apparatus was an invitation to make a demonstration upon his railway in Chicago, and he offered, if the Pennsylvania Railroad would send a train for the purpose, to invite the leading railway people and members of the press of that vicinity. The apparatus was then transferred to a train consisting of a new locomotive and six new cars, and this train was run to Chicago over the Fort Wayne Railroad, and a number of tests were immediately afterward made upon the tracks of the Chicago & Northwestern Railway, evidently to the entire satisfaction of those present. From Chicago, the train proceeded to Indianapolis, where other tests were made, and then back to Pittsburg.

The outcome of these demonstrations was immediate orders for equipment for the Michigan Central and the Chicago & Northwestern, and shortly after for the Union Pacific Railway in the West, and for the Old Colony and the Boston & Providence roads in the East.

I refer to these details to illustrate the readiness with which railway officials took up this invention and the comparative ease with which the required orders were secured, and because it has been often stated that the trials and tribulations in the introduction of the brake were of the severest nature.

Works were built in Pittsburg for the manufacture of the apparatus and were fitted with the best tools obtainable. Standards were adopted and adhered to in the parts of the apparatus which required uniformity in construction in order to insure interchange of the rolling stock so fitted upon various roads. I think I am safe in saying that the course pursued in the manufacture and introduction of the brake had a more important bearing than anything else in deciding the railway master mechanics and master car builders a few years later to take up the question of the standardization of various parts of cars in order that repairs could be more conveniently made.

It soon developed that it took considerable time to apply the brakes with full force and a longer time to release them, and that in the event of a break-in-two of a train (a frequent occurrence in those days) the rear section would be uncontrolled, and when this occurred upon an ascending gradient, the rear detached section might run away, with disastrous results. To overcome this difficulty a new development was necessary, the outcome of which has since been known as the automatic air brake.

In the automatic air brake equipment there were the same air-pump, reservoir, train pipe and brake cylinder, but in addition to these there were two important features added to the tender and each car equipment; the first, an auxiliary reservoir, and the second, a triple valve or device interposed between the brake pipe, brake cylinder and auxiliary reservoir. This triple valve was so constructed that when air was admitted to the train pipe, an opening was established between the train pipe and the auxiliary reservoir whereby the train pipe and reservoir were filled with air under pressure. The valve also opened a passage from the brake cylinder to the atmosphere. This was the normal condition of the apparatus when the brakes were off. To apply the brakes, the engineer discharged a portion of the air from the train pipe, whereupon the triple valve closed the connection between the brake pipe and the reservoir and between the brake cylinder and the atmosphere, and then opened a passage from the auxiliary reservoir to the brake cylinder, the piston of which was moved outwardly by the air from the auxiliary reservoir so as to apply the brakes. The restoration of the pressure within the brake pipe released the brakes and recharged the reservoir. This development occurred during 1872 and 1873.

The automatic brake was at that time supposed to be instantaneous in its action in applying the brakes, and almost instantaneous in releasing them. In the event of the escape of air from the train pipe by its rupture or by the separation of the train, the air stored in the auxiliary reservoirs instantly and automatically applied the brakes to all parts of the train and they could only be released by either repairing the damage and restoring the pressure, or by means of special release valves operated by the train men.

The automatic brake having proved itself vastly superior to the plain or straight air brake first described, it soon became a standard, but during the transition period an automatic brake was easily converted into a plain brake by a manually operated special valve arranged in the casing of the triple valve.

The gradual increase in the length of freight trains and the numerous accidents due to lack of brake control early suggested that automatic air brakes should be made a part of the equipment of all freight trains, and to determine the practicability of the automatic brake for this purpose a train of fifty cars was fitted in the early eighties and taken over the Alleghenies on the Pennsylvania Railroad, and the tests made demonstrated that such a train could be controlled on the heaviest gradients by this means.

In 1885 the Master Car Builders appointed a committee to report upon the feasibility of the application of brakes to freight trains, and this committee inaugurated what are now known as the Burlington (Iowa) brake trials, made in 1886 and 1887. There were presented two trains fitted with air brakes, one fitted with a vacuum brake and one with the brake operated by means of attachments to the drawbars similar to the conception first referred to. Each of these trains had fifty cars. These tests proved the inadequacy of the type of automatic air brake then presented by the Westinghouse Air Brake Company, as well as the inadequacy of all the other brakes then tested.

It becoming apparent that the lack of success at Burlington was due to the comparatively slow application of the brakes upon the rear portion of the train, the effect of which was to cause most serious shocks almost like collisions, a new development was imperatively needed in order to insure the successful handling of freight trains of fifty cars.

As a part of the automatic air brake passenger equipment, I had developed in the seventies a system of train signaling involving the use of a second train pipe, which is now in general use upon all of the railways. This signalling apparatus had a sensitive valve device connected to a small reservoir upon the locomotive, and these were so arranged that when compressed air was admitted through a small opening into the signalling pipe, both the pipe and reservoir were charged to a low pressure (at the present time to forty-five pounds). By opening a valve at any point in the train to permit a small quantity of air to escape from the signal pipe, the delicate valve referred to was caused to move so as to admit air from its auxiliary reservoir to blow a whistle located in the cab of the locomotive. It was found upon experimentation that when the valve in any car remote from the engine was quickly opened and closed as many as five times, the whistle would be blown an equal number of times, the first time being after the last escape of air; that is to say, there were set in motion five distinct waves of air, each capable of doing work.

During these developments it was found that the waves of air within the brake pipe traveled as rapidly as sound, i. e., about 1,100 feet a second.

(To be continued.)

* From Presidential Address presented at the Annual meeting of the American Society of Mechanical Engineers.

Legal Notes

A Bad Patent Bill.—Representative Oldfield, member of Congress from Arkansas, and chairman of the House Committee on Patents, introduced on May 5th, 1911, a bill (H. R. 8,776) to amend Section 4,886 R. S. to include provisions for compulsory licensing upon the order of the Commissioner of Patents and for the determination of the patent if such order be made and not complied with within a time limited. The bill also contains a Section 2 which is entirely independent of the compulsory license feature, and reads as follows:

"Sec. 2. That all patents of improvement of any new and useful art, machine, manufacture, or composition of matter shall in no event operate to extend the life of the original patent; but such patent on such improvement or improvements shall expire on the date of the expiration of the original patent."

There is little prospect of any patent legislation being effected at the present session of Congress, and doubtless full hearings will be accorded by the Patent Committee on the foregoing bill, before any report is made thereon to Congress. It requires but a casual reading of the bill to appreciate how detrimental it would be to the inventive public as well as to the public generally in stifling invention, limiting the opportunity of the inventor to properly control and profit by his invention and retarding the great commercial and other progress which necessarily results from the development of the arts by the exercise of invention under the fostering influences of the patent laws of to-day.

This idea of compulsory license is not a new one to Representative Oldfield, who introduced the new bill, for he was on the Patent Committee of the Sixty-first Congress, and he doubtless remembers the able arguments in opposition to the license proposition advanced by learned counsel at the hearings in the winter and spring of 1910, particularly that of Mr. Frederick P. Fish of Boston. On the constitutional phase of the question, Mr. Fish speaks with great force, saying:

"The Constitution of the United States, with wonderful foresight, as I look at it, says that Congress shall have the power to reward the inventor and to promote the useful arts by giving him the exclusive right for a limited time. What does that mean? It means what it says, the power to give him an exclusive right, not the power to give him some other kind of right, and the courts have so construed it. I question the constitutional power of Congress to interfere in this matter. It can make no difference whether you deal with the inventor or the assignee. If you give the inventor the exclusive right, that is one of the things he sells to the assignee. If the law is changed so that he is obliged to say 'I cannot give you the exclusive right, of course, because Congress has passed a law saying that at any time or at some time certain things may happen to take it away from you.'"

Again, on this point, Mr. Fish said, "In view of the invariable construction that has been given to the Constitution down to the present day, and in view of the conditions of the English law at the time our Constitution was established, I think the Court ought to say—I don't know what they would say—that when the Constitution said 'exclusive right' it meant that and nothing else. That is, the exclusive right to make, sell, and use, as the statute states it, and the courts have so construed it, because the Constitution required it. But that is only my view, and I hope that it will never get to the point where the constitutional question will have to be raised."

As to the practical effect of compulsory licenses Mr. Fish said:

"Compulsory license would be fatal. The whole patent system of the United States would be demoralized. The industries of the United States have a hard enough time ahead of them for several years to come and if we lose the merit of our patent system, I don't know what would happen. The whole stimulus now existing for the development and improvement of industries would in my judgment be shaken to the foundation if there should be any interference with that particular phase of the situation by which for a short time—so short, as I say, that half of it is wasted in the case of nearly every good patent—a patentee has the absolute control of his invention."

Notes for Inventors

A Machine for Selling Luncheons.—The popularity of quick lunches attracts attention to a patent for a dispensing machine, patent No. 994,717, to Frederick O. Bullis of Rochester whose machine automatically delivers a portion of food and provides for automatically measuring a portion of condiment as the food is delivered, while the delivery of the condiment is under the control of the operator.

Pipe Holder.—Pipe smokers will find some comfort in an attachment for smokers' pipes which Howard Elliott of Washington, D. C., presents in a patent No. 994,913. It is a small, neat affair, having a clamp by which it may be spring-held on the stem of a pipe with a projecting plate forming a rest to support the pipe in an upright position on a table or stand, the projecting pla also forming a means for hanging the pipe up on a hook or nail when not in use.

Enriching Coffee.—To improve the quality, soften the flavor and enrich coffee is the stated object of a patent, No. 994,785, to Ellis M. Potter of New York city. He seeks to accomplish these objects by mixing green chicory root with the green coffee bean or berry and roasting the mixture, the coffee being subsequently separated from the chicory.

Driving Devices for Gas Engine Fans.—In patent No. 994,764, assigned to Gilbert J. Loomis of Erie, Pa., the theory is applied that when the engine is running with a light load but with a high speed, the cylinder radiator or condenser is not so highly heated as when the engine is running slower. With a higher load, the invention provides means for automatically varying the relative speeds of the fan and engine so that the fan may be given a maximum velocity with the low speed of the engine and this velocity is so varied as the engine is speeded up as to keep the velocity of the fan within the limits of safety.

New Explosive.—The E. I. Du Pont de Nemours Powder Co. is the assignee of the patents 994,841 and 994,842 for inventions of Harrold Hibbert of Wilmington, Del., in explosives including butylene glycol nitrate alone and in connection with nitrates and nitro compounds.

A Westinghouse Patent.—George Westinghouse of Pittsburg has just patented No. 994,810, cooling and ventilating means for electrical apparatus in which a system of fluid passages having inlet and delivery ports are combined with rotary and stationary parts and the velocity of flow of fluid through the passages is affected by the withdrawal of the fluid from the delivery ports.

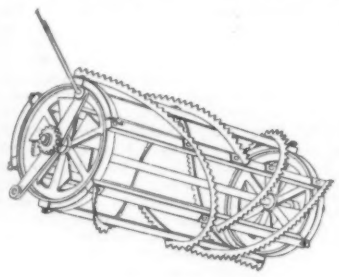
A Pocket Ink-stick.—Fountain pens are widely used and Harry N. DeLanoy of Nelsonville, N. Y., has patented No. 994,724, an ink stick or cartridge which can be conveniently carried in the pocket and cleanly handled and will render the use of a filler unnecessary. The cartridge is in the form of a porous splint whose surface film is of a coloring substance soluble in water and is formed of a dry powder adhering to the surface of the splint.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

MANURE SPREADER.—GEORGE W. BARNARD, Economy, Ind. This invention relates to manure spreaders in which the material is distributed from a wagon by means of a distributing cylinder or beater. The cylinder is shown in perspective in the engraving. The purpose is to provide a distributing cylinder which will be simple in construction and



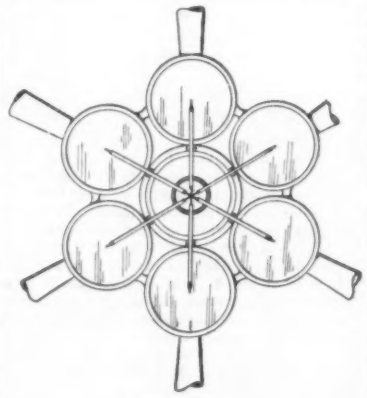
MANURE SPREADER.

reliable in operation, the distributing cylinder being so constructed that it will not only separate and practically pulverize the manure, but will scatter the same broadcast over a greater area than that occupied by the machine. Patents in this case are pending and to be taken out in Canada, Great Britain, Germany and other foreign countries.

TOOL.—W. J. STREALY, Lewisburg, W. Va. An object in this invention is to provide a device which ordinarily can be carried by inserting the handle thereof on the pole of the reaper or mower, and which, when it is desired to use the same, can be readily clamped onto the wheel of the machine and utilized to great advantage.

Of General Interest.

PHONOGRAPH.—SEPTIMUS T. E. WHITE, 308 W. 3rd St., Oklahoma, Okla., and JOHN E. WHITE, New York, N. Y. A fragmentary plan view is illustrated in the engraving, in which auxiliary sounding boxes are shown connected in multiple with the primary sounding box. The invention relates to an improvement whereby the effect of the vibrations imparted



PHONOGRAPH.

to the stylus by the disk or cylinder or any other type of secondary tablet is modified by a plurality of diaphragms, thereby increasing the distinctness of the sound. In this invention the effect of the movement of the stylus is amplified, with means for varying the number of diaphragms which will be operative at any time.

CLOTH PILER.—R. R. ATMORE, New York, N. Y. The aim in this invention is to provide, in connection with a table and a reciprocating carriage and track for supporting the same for the purpose of laying the fabric on said table in superposed folds, a guide or set of guides for properly positioning the fabric as it is being laid.

LOCK SEAM TUBE.—P. H. FRIEL, New York, N. Y. This improvement provides means for interlocking the various layers of metal wherefrom the completed tube is constructed in a form wherein the joined ends of each layer are prevented from spreading by the body structure of the other layer; and provides a tube constructed of a series of layers arranged to form a continuous wall having an even thickness.

IRRIGATING SYSTEM.—J. T. DONAHOO, Edgar, Neb. An object here is to provide a system which may be successfully employed in those valleys in which there is a stream of water at whose level the land of the valley is more or less wet. Another is to provide a system in which lands at some distance from the stream may be irrigated without the necessity of making ditches or canals leading from the stream itself.

Hardware and Tools.

SAW GUIDE.—C. KESSLER, Elk, Wash. The guide is adapted to be secured to a tree and to hold a saw therein, and to guide the saw as it cuts into the tree, so that the angle of cut can be controlled at all times. Use is made of a support for securing the support to the tree, and a series of adjustably connected supports, and a saw guide adjustably mounted on one of the supports and adapted to slide in the guide.

WRENCH.—ARTHUR S. E. METCALF, Driscoll, N. D. This invention relates to wrenches, and the more particular purpose is to provide a tool of this general character suitable for

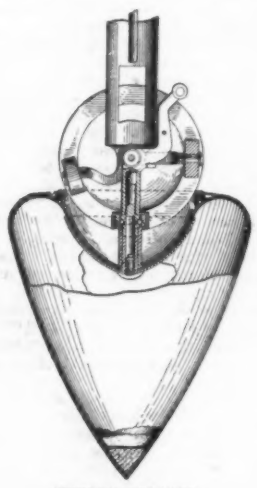
WRENCH.

use either alone as a hand instrument or in combination with a rotary brace. More particularly stated the invention shown in the engraving provides a wrench having a two-part shank adapted to be bent and used as a handle or to be straightened and put into a brace, the tool further comprising various portions whereby it is adapted to be used as an alligator wrench, a monkey wrench, or a socket wrench.

CLAMP.—E. ADELL, Orange, Mass. In this case the invention provides a clamp for removably clamping articles of various dimensions and proportions. Use is made of handled clamping screws, having clamping bars operatively mounted thereon, with means in one of the bars for screw threadedly engaging the clamping screws and means in the other clamping bar for preventing the said bar from sliding longitudinally on one of the clamping screws.

Household Utilities.

WINDOW CLEANER—JOHN W. GIBBONS, 2725 Jackson St., Baker City, Ore. The invention illustrated by the engraving relates to a device for cleaning windows or the like, which



WINDOW CLEANER.

is in the form of a flexible pneumatic wiper that is adapted to be rotated by a suitable source of power at any suitable angle. An object is to provide a cleaner with a buffer, and means for tilting the buffer to various angles with its support; to provide a tiltable pneumatic buffer with means for tilting the same from the source of power, and with means for automatically disconnecting the tilting means from the source of power when a predetermined position of the buffer has been reached; and to provide a cleaner which may be adjusted as to its length without interfering with the source of power.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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NEW BOOKS, ETC.

DICTIONARY OF AVIATION. By Robert Morris Pierce. New York: The Baker & Taylor Company, 1911. 287 pp. Price, $1.50 net.

In his preface Mr. Pierce tells us that it has been his attempt "to produce a word book for the use of persons interested in aviation from any of the various points of view from which it may be contemplated, or from any of the starting points from which it may be pursued." That he has succeeded in this attempt, for the most cursory examination of the book readily prove. In the effort to be complete we find many a curious compound which has unnecessarily swelled the volume of words. Thus we find such unnecessary combinations as "aeroplane-accident," "aeroplane-experiment," "aeroplane-flight," "aeroplane-owner," "aeroplane-race," "aeroplane-term," "aeroplane-tower," and "aeroplane-work." Compounds such as these may be produced almost by the hundred. Perhaps that explains why this dictionary contains no fewer than 4,276 title-words and phrases. In the definition of a helicopter, we are told that such machines depend "for lifting or sustaining power upon vertical screws or rotating air foils," where evidently a horizontal screw is meant.

THE NEW INTERNATIONAL YEAR BOOK. New York: Dodd, Mead & Co., 1911, 837 pp.

Among the noteworthy features of this year's International Year Book, which may well be regarded as an annual encyclopedia, are politics, current history, and biography. Subjects such as the referendum and initiative, conservation, municipal government, banks and banking, strikes and lockouts, arbitration, in other words, subjects which have occupied considerable space in the public press during the past year, are treated with commendable fullness. On the other hand, we find the division or aeronautics rather one-sided. The developments in aviation are summarized well, considering the limitations of space; but the development of the dirigible, which has been truly remarkable, is limited to an account of Wellman's "America," the Zeppelin airships, the Willows dirigible, and the "Clement-Bayard II," notwithstanding the fact that the Parsevals have made wonderful records, and that almost every military power of Europe has for two years past been engaged in the building of dirigibles. The article on astronomy is good. As is natural, considerable space is devoted to Halley's comet. It is no longer seriously thought by astronomers that light pressure is the sole cause of the phenomena of the comet's tail. More space should have been devoted to the discussion of new stars. The topics under the head of industrial chemistry seem to have been rather arbitrarily selected. Considerable space is devoted to radium, paper and fiber, artificial rubber, permutite filtering, but no space at all to the industrial application of the new coal-tar dyes, perfumes, and the like. Achievements in electro-chemistry and electro-metallurgy, in which new events may be recorded almost from month to month, find no place whatever in this volume, through some curious oversight. Indeed, in science and engineering the Year Book seems to be weakest, and it is just here where it should be at least as strong as in other portions. The criticisms made should not militate too seriously against the book, for there can be no doubt that as a piece of painstaking compilation of happenings during the past year it will prove a valuable reference book.

A CONCISE HISTORY OF CHEMISTRY. By T. P. Hilditch. New York: D. Van Nostrand Company, 1911. 263 pp. Price, $1.25.

Considerable interest is being manifested at the present time in the history of arts and science. It seems indeed as if no rational person, living in this age of the most remarkable scientific achievements, could remain in perfect indifference, never giving a thought to the inquiry after the origin and growth of this wonderful element of our civilization. To the student of science, some familiarity with the history of his subject is indispensable for a thoroughly intelligent grasp of his work. It is true that perhaps the best mode of acquiring this familiarity is through the consultation of the original publications. The process of thus imbibing historical knowledge is, however, slow, and for the most part falls into the period of a man's life work rather than into his college years. For reading to be carried on concurrently with the younger student's regular work, such a hand book as the one before us is eminently desirable. The author gives a brief but very excellent survey of the principal phases of the history of chemistry. The text is divided into eleven chapters, under the following headings: I. The Evolution of the Science. II. The Chemical History of Fire, Air, and Water. III. The Ultimate Constitution of Matter. IV. Inorganic Compounds and the Laws of Chemical Combination. V. Notes on the History of the Elements and their Chief Compounds. VI. The History of Organic Chemistry. VII. Compounds and Reactions in Organic Chemistry. VIII. The Chemistry of Plant and Animal Life. IX. The Application of Chemistry to Manufactures. X. The History of Physical Chemistry. XI. The Progress of Experimental Method. There are two appendices, the first giving a biographical index of the great chemists, a brief *résumé* of the man's most important contributions to science being given under each name. The second appendix is a tabular summary, in chronological order, of chemical events of outstanding interest. The book is one of more than ordinary merit.

MODERN GUNS AND GUNNERY. A Practical Manual for Officers of the Horse, Field, and Mountain Artillery. By Brevet-Colonel H. A. Bethell, Royal Field Artillery, Woolwich. F. J. Cattermole, Wellington Street, 1910.

This comprehensive and admirable work has been written for the use of officers who may be deterred from a study of some other text books because of the real or imaginary terrors of the mathematical demonstrations with which their pages are apt to bristle. While the designer of guns, carriages, and amunition must have an exact mathematical knowledge of the science of gunnery, the officer who uses the gun need have no more than a clear understanding of the principles of gunnery to enable him to apply these principles in handling the guns. This work is intended first as an easily understood manual for those whose whole duty leaves them no time to master the difficult science of gunnery, and secondly it is intended as an introduction to the study of more advanced books. The last edition, written in 1904, has been thoroughly rewritten in producing the present work. The theoretical portion has been altered, the ballistic tables made more perfect, and some of the older theories have been modified by recent experience. The book is divided into four parts, consisting of "Theoretical Gunnery"; "Principles of Construction of Guns, Carriages, and Amunition"; "Practical Gunnery"; "Modern Quick-firing Equipments"; and "Gunnery Calculations." It is sufficient to say that the author has succeeded thoroughly in his aim to be comprehensive and clearly understood. The work is abundantly and judiciously illustrated, and is one of the best of its kind that it has been our pleasure to review.

THE SEVEN FOLLIES OF SCIENCE. By John Phin. New York: D. Van Nostrand Company, 1911. 231 pp.; 34 illustrations. Price, $1.25.

This is the second edition of a book which has deservedly found favor. The follies enumerated are: Squaring the circle, the Duplication of the Cube, the Trisection of the Angle, Perpetual motion, the Alchemical transmutation of metals, the Fixation of mercury, the Universal medicine and the elixir of life. These seven follies constituted practically all of the first edition of this book. In this second edition will be found discussions of perpetual or ever-burning lamps, the alkahest or universal solvent, palingenesy, the powder of sympathy, besides a number of paradoxes, illusions, and marvels which should hardly find a place in this book, and which include the Fourth Dimension, How a space may be apparently enlarged by merely changing its shape, Can a man lift himself by the straps of his boots? How a spider lifted a snake, How the shadow may be made to move backward on the sundial, How a watch may be used as a compass, etc. We rather wonder, too, why curious arithmetical problems should have been included in this book. More appropriate is the discussion of such popular fallacies as the following: That most great discoveries are made by accident, That the idea of the steam engine was suggested by a teakettle, That whetstones are oiled to lessen friction, That lightning never strikes twice in the same place, That the first fire came from branches of trees moved by the wind, That volcanoes are burning mountains, That the force of dynamite is always exerted downward, That steam can be seen, etc.

THE OPEN BOOK OF NATURE. An Introduction to Nature Study. By the Rev. Charles A. Hall. New York: The Macmillan Company, 1911. 8vo.; 288 pp.; illustrated. Price, $1.75 net.

Nature with an English background is here pictured in such a way that young readers may be drawn toward its mysteries and its delights, while older readers who have not yet known the joy that rightly-directed observation and the discovery of underlying facts always brings, may taste of the purest pleasure this life has to offer. The illustrations—of scenery, plants, birds, animals, and fossils—include some beautiful reproductions in color besides scores of studies in black and white. We are taught to read the signs of the ground we walk over, to identify the commoner fossils, to name the birds and to know their eggs, to name the wild flowers and learn their well-loved nooks. There is a glossary which will prove very useful.

HOW TO USE THE ELECTRIC LIGHT WITH INCREASED ECONOMY AND EFFICIENCY. Including a Chapter on Electric Heating. By Frederick H. Taylor. London: Percival Marshall & Co. 76 pp. Price, 25 cents.

A simple instruction book for householders, shop-keepers, and factory owners. It contains enough good hints to make its perusal by the consumer of electricity well worth while, but it must be read with the understanding that it is written from the standpoint of the electrical industry and with reference to English conditions, which in many instances differ greatly from those of America.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12474) R. L. says: In SUPPLEMENT No. 1217, in an article on liquid air, the statement was made that liquid air could be poured over the hands without producing much sensation, on account of the heat of the hand forming a thin layer of gas between the hand and liquid air. How long could the hand remain submerged without being damaged? A. The hand cannot remain submerged in liquid air for any time without being frozen. It can be put into liquid air and taken out again without injury if this is done so quickly that the heat of the hand cannot be absorbed by the cold liquid. Heat cannot pass out of the hand in an instant. 2. I have read several different times that the strength of iron and steel was doubled (that at ordinary temperature) when cooled to the temperature of liquid air. Now then, why is it that tools made of a high grade of steel, such as saws and hammers, break very easily when they are at that temperature called frosted? A. The tensile strength of iron becomes approximately doubled at the temperature of liquid air. Lead becomes elastic like steel. Iron and steel become very brittle at such low temperatures, and break like glass by bending. Tensile strength and flexibility are not similar properties. 3. In their search for a motor seasonably immune from stoppage, why don't the flying machine men use the steam engine, such as are used on some automobiles? A. The weight of the steam boiler and engine with its supply of water is against it. Thus far no one has been able to construct a steam engine anywhere near as light as the gasoline engine. 4. I have heard that a man in a balloon has reached an elevation of seven miles above sea level. What is the atmospheric pressure at that height? Is the oxygen proportion the same as at sea level? A. The highest balloon ascent of which we have a record is 34,450 feet. The barometer stood at 7.95 inches. This is something less than seven miles. We have no record of the composition of the air at that elevation. The kinetic theory of gases would indicate that there should be less oxygen at that altitude than at the level of the sea. 5. The SCIENTIFIC AMERICAN has stated many times that the highest temperature attained by man was the electric arc (estimated at some 7,000 degrees). I have here a calculation that seems to contradict that statement. Take the case of the oxygen hydrogen combustion, allowing 50 per cent excess oxygen to make complete combustion more certain. I obtain about 12,000 deg. Fahr. In the combustion of carbon-oxygen the temperature is still greater. I obtain 15,494 degrees total, considerably hotter than the oxygen-hydrogen combustion under the same conditions. What do you think of that? A. We are not able to assent to the assumptions upon which your determinations of the temperatures reached by various combustions are based. Your results could be true only if all the heat were received and retained by the resulting gases and if all the gas were heated uniformly throughout, and that instantaneously. All of which is impossible to attain. Your results may be called potential temperatures, but nothing more. They are far from actual. The impossibility may be realized from the statement that oxygen and hydrogen begin to dissociate at 2700 deg. F. and have reached their limit at 4500 deg. F. At a temperature of 12,000 deg. F. chemical action of oxygen upon hydrogen is impossible. They would remain perfectly inert in each other's society. It is impossible to give figures for the temperature limit in the cases you present. Kent, in his "Mechanical Engineer's Pocket Book," new edition, pages 785-6, gives a formula for calculating the temperature of combustion of materials containing carbon, hydrogen, oxygen, and water vapor. But he says that the temperatures obtained by experiment are below those obtained by calculation, for which he gives certain reasons. We send the book for $5.

(12475) O. J. C. asks: We are occupying a steel concrete building here which was finished one year ago. On the rear wall of our store room and basement we have had foil strips glued up and down on these walls, through which the current passes for the burglar protection. Through either chemical action or moisture the current is so much interrupted that we cannot use the burglar protection, and the foil itself seems to have gone through a chemical process, so that it rubs off like powder. Now what we wish to ask is if there is anything that you know of in the way of a thin covering that we can put over these walls so as to make them moisture-proof, and to which these foil strips can be attached, and work with satisfaction. A. A coating of shellac will render tinfoil moisture proof. This is used in various electrical apparatus for this purpose, such as condensers, where it is very necessary to keep out the water. The shellac will act as a glue to make the foil adhere to the wall. The glue will not be necessary. The shellac is a good insulator also. Asphaltum varnish will serve the same purpose.

(12476) H. O. S. asks: As I have always understood that any object that gives forth different tones by increased or decreased vibrations gives forth but one tone at any one instant or the smallest fraction of a second, will you kindly explain whether the reproducer of a talking machine, during a band selection, for instance, when several instruments are each making a different tone at the same instant, actually gives out the several tones at any instant, or apparently does so by the predominating tones following each other so rapidly in such a small fraction of a second that the ear is unable to realize it? A. The exact nature of the record in a talking machine is not clearly known. Much investigation has been spent upon it. Many papers have been published giving the reproductions of the tracings of the reproducers much enlarged. But the indentations are so minute and of so little depth, that very little progress has been made in this research. A very good report of this work may be found in the recent textbook of Sound by Prof. Barton of Nottingham. We will send the book postpaid for $3. It does not, however, answer your question. Perhaps the only certainty is that you actually hear the music of a band in the phonograph just as if you were listening to the instruments when the sound is directy transmitted through air. We are inclined to the opinion that the reproducer actually gives out the several tones just as they went into the recorder.

(12477) G. E. A. asks how to find the specific gravity of water, and how to find out the difference in draft of a ship in salt water and fresh water. A. The specific gravity of fresh or pure water is 1. It is the material with which all other materials are compared, and hence is assumed as unity. The specific gravity of sea water varies from 1.025 to 1.03, according to its degree of saltness. A ship will displace the same weight of salt water as of fresh. The fresh water would occupy the larger volume, and the ship would sink deeper in it. Taking the salt water as the usual medium for a ship to float in, and the volume of fresh water displaced by it will be 1025/1000 of the volume of salt water displaced by it. As "draft" is the vertical depth from water line to lowest point of keel, the increased draft of ship in fresh water as compared with salt depends upon the shape of the ship. One vessel might sink an extra inch and another a foot or two in fresh water. By calculation from the hull drawings, marine engineers can determine the exact displacement of a ship at any depth of immersion. The weight of ship and cargo equals the weight of the displaced water. Therefore to move a ship from salt to fresh water changes its draft an amount equal to the change that would occur if the ship's total weight (including cargo) were increased by the specific gravity of salt water—1.025 to 1.03. In other words, it would draw as much more as if it were loaded an additional three per cent.

(12478) C. P. DuS. writes: Can you send me the alphabet commonly used in wireless service, with the name of an advertiser who will furnish me with an outfit? A. You will find the Morse and Continental alphabets used in the wireless telegraph in Collin's "Wireless Telegraph Handbook," which we send or $1.50. We must be excused from copying them when they are accessible in printed form.

(12479) P. W. B. asks: 1. What form of tuning fork, cylinder wire, or other mechanism, is the most sensitive to sounds produced by other means of a mechanical nature of the voice? A. A tuning fork mounted upon a proper resonant box, will take up and reproduce any sound of exactly the same period as its own, and so reproduce it. So too will a piano string, as you may prove by raising the loud pedal and singing a note into the piano. You will find several strings to be giving forth their tones, which are the overtones of your voice when singing that note. We do not know anything more sensitive than this. 2. Is there any instrument made, or how can I make, or have made an instrument that can be attuned to various sounds, as given on the piano, say, or on a harp, or violin? A. There is an instrument called the phonautograph which registers any tone spoken or sung into it. This you can learn about by addressing Queen & Co., 59 Fifth Avenue, New York. 3. What books are the best authority on acoustics, or study of sounds and methods of testing them out, or attuning other things to them? I am not up in this line, nor am I a scientific man, other than from general reading but not from a mathematical standpoint, so something of a simple nature is apt to be of more value to me, and with this in mind, your reference will be gaged, if you please. A. The latest book on acoustics is Barton's "Textbook of Sound," which we will send for $3. It contains a chapter upon sound recorders and reproducers.

Lithopone and Its Manufacture

By S. Bose

ATTEMPTS had long been made to manufacture a real white paint of high covering power from baryte, otherwise known as heavy spar, which has been used largely as an adulterant to other white pigments. The various attempts met with success both in Germany and England when the substance commercially known as lithopone was made. It has also since been known by its other commercial names, such as Orr's white, Jersey Lily white, ponolith, oleum white, and others given by various manufacturers. It is a chemical compound, the constitutents being zinc sulphide 29.5 per cent and barium sulphate 70.5 per cent. When fairly pure solutions of known strength and proper temperature of zinc sulphate and barium sulphide are mixed in their molecular proportions, a heavy flocculent easily filtered precipitate is obtained according to the formula:

$$Zn\,SO_4 + BaS + H_2O = ZnS + BaSO_4 + H_2O.$$

This precipitate, however, has very little covering power. John B. Orr, of England, discovered that when it is heated to a dull redness and suddenly plunged in cold water and then thoroughly ground, washed, and dried, it is completely changed into a new substance, although with no chemical change, far excelling in its qualities most of the white paints. The cause of this change is not well known. It seems probable that this treatment causes an internal re-arrangement of the molecules. The different commercial samples vary in their composition to a slight extent, and the modes of the manufacture are kept as trade secrets. In recent years the quality of the substance has been much improved and made uniform. There is no difficulty or much complication in its manufacture, success depending to a large extent on the purity of the substances used and those again are more or less easily prepared. But the manipulation must be carried on with care and knowledge, as otherwise the result will be unsatisfactory and the presence of impurities will make the paint colored and totally unfit for the purposes for which it is used.

The barium sulphide is made in the following way: About 100 parts of finely powdered baryte and 20 parts of coal slack or charcoal, petroleum residue, pitch, sawdust, or any other substance with a high percentage of carbon also finely powdered are mixed thoroughly and heated to dull redness without any contact with air. Asphalt of gas works is a capital reducing agent, as the hydrogen contained in it prevents the formation of polysulphides of barium. The argol residue from tartaric acid vats is also a good reducing agent. Another method used in some factories consists in mixing 100 parts baryte, 200 parts common salt, 15 parts charcoal powder, and roasting the materials in a reverberatory furnace, the salt being used to assist fusion. At the time of roasting the following reaction is supposed to take place:

$$BaSO_4 + 4C = BaS + 4CO.$$

When the reaction is complete, avoiding contact with air as much as possible, the barium sulphide is leached out after digesting the mass in vats and filtered. When the solution reaches a density of 17 degrees Beaume, long yellowish needle-like crystals separate out from the mother liquor, consisting of chemically pure barium sulphide. Any impurities in the baryte generally do not affect the purity of the barium sulphide formed. The metals, like copper, iron, and manganese that are occasionally present in the baryte, form insoluble sulphides, whereas barium sulphide is completely soluble. Barium sulphide has a hepatic odor and alkaline taste, and in water forms a mixture of barium hydrate and barium sulph-hydrate:

$$2BaS + 2H_2O = Ba(SH)_2 + Ba(OH)_2.$$

It should not be exposed long to the air, as it is then converted into $Ba\,CO_3$ and H_2S given off owing to absorption of moisture and CO_2.

With about 60 per cent concentration of the solutions and temperature of 60-65 deg. C., and when the zinc sulphate is poured on a vat at double the rate at which the BaS is poured we get a characteristic precipitate most easily filtered and dried. It is now placed in muffles and heated above 920 deg F., suddenly plunged into water, ground, washed thoroughly and dried and is ready for the market. Overheating should be avoided, as some of the ZnS then becomes converted into zinc oxide. Formerly 5 to 10 per cent of zinc oxide used to be present invariably in the commercial product, but as its presence decreases to a small extent the efficiency of the paint, the heating is so regulated that the percentage of zinc oxide present is very small.

Last year I carried on about twenty experiments in an attempt to make lithopone from baryte and the zinc carbonate mineral known as smithsonite and secured fairly good results. For reducing agent I used argol residue from tartaric acid vats containing about 95 per cent carbon. A slow prolonged heating to dull redness for about eight hours gave the best yield of BaS—about 56 per cent. Heating at a high temperature for three to four hours also gave fairly good, but somewhat low, results, varying from 40 to 48 per cent. The BaS was almost pure. For the manufacture of $ZnSO_4$ from the carbonate, I got fairly satisfactory results from a method I devised. The ore was finely powdered and treated with crude H_2SO_4 and heated when a lumpy mass is formed and when hard it was powdered and roasted. There was about 2 per cent of iron in the ore which was oxidized and the zinc sulphate was then leached out by digesting with hot water. Another good method is to dissolve the mineral in H_2SO_4 and then treat the soiution with bleaching powder and remove the precipitate by filtration, the iron being thus eliminated.

Lithopone has had quite a history in the market. When first brought out it was condemned as a hoax, as nobody would believe that $BaSO_4$ could form a paint. But it has been able to outlive its condemnation by sheer merit. It is one of the most effective and durable of white paints. In the brilliant white of its color, its fine texture, and hiding power, it is scarcely surpassed by any one white paint, and change of weather or atmosphere has practically no effect on it. It finds use in many industries. It is indispensable and largely used in the manufacture of floor oil-cloth, as it does not oxidize in time, and also in the cheaper grades of enamel paints, as it does not combine with rosin or semi-fossil resin varnishes. As a ready-made paint, it can be kept for an indefinite period in the package without deterioration. It is far better as a marine paint than zinc oxide and lead carbonate. Mr. Toch, the well-known expert on paint, sums up its qualities in the following words: "As an interior white, a first-coat white, a ready-mixed flat paint for surface, or as a pigment in the lighter shades for floor paints, lithopone cannot be excelled for its body, durability, hardness, fineness of grain, and ease of application." Mr. Toch also notices one peculiar habit, its photogenic property, i. e., its power to absorb light and give it out again. When it is mixed with linseed oil or varnish and then exposed to the direct rays of the sun, it turns grayish readily, and in shade regains its normal color. The reason of this is not known. But Prof. Ostwald has succeeded in eliminating this power of lithopone, and the discovery is covered with patents. Some chemists have tried to explain this by saying that the coloration was due to lead forming a lead sulphide. But this does not seem to be a satisfactory explanation, for in the manufacture of floor oil-cloth lead driers are always used and no coloration results, and moreover ZnS seldom liberates its sulphur in the presence of any neutral salt, and so strong is the chemical union that it is perfectly stable in the presence of organic acids.

It is rather interesting to know that $BaSO_4$ is regarded in this country as an adulterant, thus lowering the value of a paint containing it, whereas in Europe its presence in paints, especially white lead, is valued for its whiteness, elasticity, on account of its insolubility in acids, its greater covering power, and

its resistance to atmospheric gases and changes of weather. Baryte is now an important mineral for its extensive industrial uses. It is used in the manufacture of paper and rope to give weight, and it forms a covering to canvas sacks in which ham is sent to the market. The carbonate mineral witherite used to be the chief source of $Ba(OH)_2$, but owing to its rarity in commercial quantities baryte has become the source of other barium compounds. The greatest possible use of baryte is in beet-sugar industry in the separation of sugar from molasses, and some claim that it is also applicable to cane sugar industry. It is also used to purify water in steam boilers and in the preparation of hides in tanning. It occurs extensively in this country in Missouri, North Carolina, Tennessee, Illinois, Kentucky, Virginia, but the annual production is rather small—about 61,668 short tons, value $203,154 (1902), of which more than half came from Missouri. It is also imported in small quantities from outside.

Aviation Sickness

MODERN progress is not without its drawbacks, as would appear from the fact that after being familiar with mountain sickness, we are now to have the "aviator's sickness" inflicted upon us. This expression does not mean any slight upon the numerous contingent of aeroplane flyers, but is an actual sickness which is felt by aeronauts, and Dr. Dastre spoke about it at one of the meetings of the French Academy of Sciences. Several doctors were at work observing it recently, and especially during the Bordeaux aeronautic week. They noticed the effect upon the pilots of aeroplanes when flying very high, and also mounting or coming down very quickly. When mounting in the air, they find that breathing becomes shorter when at 5,000 feet height, and this effect is more noticeable than with ordinary balloons. The heart is noticed to beat faster, but generally there are no palpitations, and there is only a slight ill feeling which the aviator Morane thinks is a nervous sensation due to anxiety and the emptiness of space. Buzzing in the ears is noticed only at a greater height, about 6,000 feet, although Legagneux felt a cracking noise in the ears when flying lower than this. According to Morane, the view is always very clear, but another flyer had veritable hallucinations on one of his trips, and at each instant he imagined that he saw the tower of Notre Dame on his right, although he was hundreds of miles from Paris.

When flying at 3,500 feet, and especially above 5,000 feet, the reflex movements of the system have a greater amplitude. This appears to be due to a combination of causes, such as cold, a more rapid breathing, quicker heart beats, the effect of sunlight and troubles of hearing, to which we must add nervous tension and fatigue. The doctors also noticed what were the effects of a rapid descent in an aeroplane, and these appear to be a burning sensation in the face and redness. One curious effect is a great tendency to sleep, and this is so strong that the eyes sometimes close in spite of all efforts to keep them open. We must take it on the authority of Dr. Dastre that not long since a young pilot started out on an aeroplane flight, and was afterwards found fast asleep in the open fields. When awakened, he did not remember how he had come down. Thus the different kinds of "aviator's sickness" are likely to give some startling results.

High Tension Discharge Apparatus

AT the recent soiree of the Royal Society, Prof. E. Wilson and Mr. W. H. Wilson exhibited an improved high tension discharge apparatus. Energy is stored in a magnetic field by inductance, from a low frequency circuit, and when so stored the condenser is mechanically bridged across the primary winding of an induction coil, thus forming a high frequency oscillating circuit. The energy is then transferred by the secondary winding to the work circuit. The above cycle of events is controlled by a motor-driven interrupter. Tapping points on the inductance winding allow of a suitable range of voltages being used.

Aeronautics

Detroit Aviation Meet.—About $15,000 has been raised for prizes for the Detroit meet, which is to be held for 6 days from June 29th to July 4th inclusive.

Aeroplanes in Department Stores.—As he was the first to exhibit a Blériot monoplane in his stores in New York and Philadelphia, so John Wanamaker is also the first to put an aeroplane on sale in his New York store. He is exhibiting there a Moisant monoplane of the Blériot type, which is shown equipped with an Anzani motor for the sum of $4,000. There is also on exhibition an imported French balloon, the price of which is but $1,500. It is probable that other department stores will adopt this idea, which will enable ardent aviators to purchase machines at a moment's notice, if not to fly them as quickly.

The International Speed Race.—For the third time the French will try to capture the Bennett trophy in England on July 1st. France has a better team this year than ever before. Alfred Leblanc will again pilot a 100 horse-power Blériot and will have as team mates M. Edouard Nieuport and M. Chevalier on Nieuport monoplanes, which machine holds the record for nearly the distance of the race—145 kilometers—at 80 miles an hour. Aubrun will be the substitute if any is needed. To defend the cup England will have Gustave Hamel with a 100 horse-power Blériot, Alex. Ogilvie with a powerful "baby" Wright, and one other aviator yet to be chosen. America will have only Charles T. Weymann, who, nevertheless, stands a good chance with a fast Nieuport monoplane. Austria will send Herr Flesch, with a fast monoplane, and Germany will also be represented. The race will be run at Eastchurch, Isle of Sheppey, and will start at 11:46½ A. M.

Hamilton Flies Around the Connecticut State Capitol.—Emulating Tom Sopwith's flight around the Philadelphia city hall recently, Chas. K. Hamilton flew about 10 miles from New Britain, Conn. (his home town), to Hartford, where he circled several times the 274-foot-high dome of the capitol before flying over the heart of the city and continuing for 15 miles farther up the Connecticut River toward Springfield. Hamilton turned without alighting and flew back home. His flight was a demonstration of the freedom of the aviator. After Jan. 1st, 1912, all aviators, balloonists and dirigible pilots must obtain a license in order to fly in the Nutmeg State, and no one under 21 years of age can enjoy any of these sports. This is in accordance with the provisions of the bill drafted by A. Holland Forbes and recently rushed through the Connecticut legislature. Having fallen through the roof of a house once himself the famous balloonist wants to protect his fellow citizens, as far as possible, from the chance of any such accident.

The Waltham, Mass., Meet.—The second aviation meet to be held near Boston occurred at Waltham from June 15th to the 20th. Jas. V. Martin, who has lately returned from England with his wife, who is also a flier, made some excellent exhibition flights with a Blériot monoplane and a Burgess biplane. Ovington made several sensational flights over Waltham, Boston, and the surrounding towns. In his longest flight across Boston he was gone half an hour. He flew across the city and out over the harbor and back. Harry Atwood with his Burgess-Wright biplane made a number of cross-country trips with passengers, the chief of which was his trip to Concord, N. H., with a passenger. He flew in a very strong wind and stopped to change passengers at Lowell, Nashua, and Manchester. He covered 75 miles in about two hours flying time. The following day he flew still farther with another passenger. Atwood's flights in a Wright machine in a strong wind are in line with the performance of Ogilvie in an N.E.C.-engined Wright in England recently, when the wind was so strong that the aeroplane hovered above a given spot and could make no forward progress.

Electricity

Telephone Train Dispatching on the Lehigh Valley.—A large part of the Lehigh Valley Railroad now uses the telephone for train dispatching. It was decided recently to extend this system to practically the entire road. An order has been placed for the apparatus, and with the exception of a short stretch of ninety miles on the West Buffalo Division, the entire Lehigh Railroad will soon be using the telephone train dispatching apparatus.

Electric Lights in the Society Islands.—According to a recent consular report, an American living at Papeete, in the Society Islands, has installed an electric lighting system in the city. He has placed at the street crossings 100 candle-power lamps, with 40 candle-power lamps at other points. The lights are very astonishing to the natives, who travel miles to see them. The plant consists of two 30-kilowatt generators, one 10-kilowatt generator, and one 5-kilowatt generator, with a total capacity of 3,000 20 candle-power lamps.

Mining Gold with Electric Dredges.—More than twenty-five per cent of the gold mined in California is now recovered by means of dredges. Formerly the dredges were operated by steam power, but this was expensive owing to the scarcity of fuel. Now that California is utilizing its streams for the generation of electricity, electric power is available throughout the State at low costs. Gold dredges are accordingly being equipped with electric motors, which have not only proved more economical but have shown themselves to be more adaptable for this class of work because of their ability to run continuously without much attention and with almost perfect reliability.

Pilot Cells for Electric Vehicle Batteries.—It is not always possible to judge accurately of the condition of a battery with a voltmeter, particularly if the battery is not new. Heretofore, however, this has been practically the only method that could be used, for the reason that the cells are sealed and it is a difficult matter to reach the electrolyte for the hygrometer tests. As however the hygrometer test is the only reliable one, a storage battery manufacturer has recently brought out a pilot cell in which a hygrometer is permanently incased behind a small glass-covered opening. Readings may be taken at any time and a card attached at one side of the battery shows the mileage available for different gravities.

Protecting Pipes Against Electrolysis.—It is well known that underground pipes are injured, not when stray currents enter them, but when they leave them. Such being the case, the city of Karlsruhe, in Germany, has used a system which will prevent a stray current from leaving the pipe. A set of plates and pipes are buried close to the water pipe at the points where electrolysis is liable to occur and these are connected to the positive pole of a storage battery or generator, while the water pipe is connected to the negative pole. As the voltage of the stray currents that produce electrolysis is usually quite low, the expenditure of power required to maintain the requisite current in the water pipe is not costly. So far this system has proved very efficient.

Measuring Candle Power with a Thermopile.—In a paper read before the London Royal Society, of recent date, A. R. Houstoun referred to a system for measuring candle power by means of the thermopile. Ordinarily this is impossible owing to the fact that the thermopile is affected by invisible as well as the visible waves. However, it was found that by using a light filter consisting of solutions of copper sulphate and potassium bichromate the ultra-violet and infra-red rays are entirely stopped so that only the visible portion of the spectrum passes through and impinges upon the thermopile. The author suggests that this means be used for measuring the intensity of light, employing as a unit that intensity which would produce 0.8 erg per square meter per second at a distance of one meter.

Science

Michelsen Honored at Goettingen.—The University of Goettingen on June 15th conferred the honorary degree of doctor of philosophy upon Prof. Albert A. Michelsen, of the University of Chicago, and exchange professor at Goettingen.

Wolf's Periodic Comet.—A cablegram has been received at Harvard College Observatory from Kiel stating that Wolf's Periodic Comet was observed by Prof. Max Wolf at Heidelberg, 1911, June 19. 4792 in R. A. 18 h. 46 m. 16s., Dec. +13° 28′. The comet is visible in a large telescope.

Anti-Typhoid Vaccination in the Army.—On the recommendation of Major-General Leonard Wood, Chief of Staff, the Secretary of War has ordered that anti-typhoid vaccination, which for more than a year has been voluntary in the army, shall be administered to all recruits except those over 35 years of age.

An Expedition to Jan Mayen.—The American Geographical Society has received notice that Mr. J. Foster Stackhouse, of England, has organized an expedition to visit, during the present summer, the island of Jan Mayen, which lies far to the northeast of Iceland, in the direction of Spitzbergen. With the expedition will go, as geologist, Mr. W. S. C. Russell, of the Central High School, Springfield, Mass. Jan Mayen was one of the points occupied by the international polar expeditions of 1882-1883; viz., by the Austrian expedition under Wohlgemuth.

Wireless Communication with Spitzbergen.—Roughly speaking, Spitzbergen lies a thousand miles north of the Arctic Circle, but, in contrast to other regions of equally high latitude, it has become the field of active exploitation. Its coal mines are being worked most profitably, and it is now visited every summer, not only by the fishing-fleets, but by large parties of tourists. The great need of telegraphic communication is about to be met by the Norwegian government, which has decided to establish a wireless station at Green Harbor. The nearest point of wireless communication will be Hammerfest, 750 miles distant.

Meteorological Stations in the South Pacific.—The director of the Chilean meteorological service, Dr. Walter Knoche, recently began a cruise on the naval school-ship "General Baquedano" in the course of which he was to establish a first-order meteorological station on Easter Island, the most easterly island of Polynesia. It is intended to keep this station in operation for at least two or three years. Seismological observations will shortly be undertaken at the same point, under the direction of the Chilean Seismological Institute. On his return voyage Dr. Knoche expected to stop at the island of Juan Fernandez, where, if possible, another meteorological and seismological station was to be established. As this island is to have wireless telegraphic communication with the mainland, it is probable that Juan Fernandez (the *locale* of "Robinson Crusoe") will become an important outpost of the weather forecasting service of Chile.

Amundsen's Antarctic Expedition.—As already reported in this journal, Capt. Amundsen, who left Norway ostensibly for the Arctic regions, where he proposed to make a five years' drift across the Polar Sea, recently turned up, to the surprise of the scientific world, in the Antarctic, where he was found by the English ship "Terra Nova" preparing for an attack on the south pole. His change of plans has now been explained by Dr. Nansen, in a letter to the London *Times*. It appears that he wrote to Nansen from Madeira that, owing to the diminished popular interest in the north pole since the successful result of Peary's last expedition, he felt convinced that he should not be able to raise sufficient money for the proposed long voyage in the Arctic. He therefore decided upon the more popular and less expensive plan of vying with Scott, Filchner and the others in a dash for the south pole. A press dispatch, dated June 17th, states that Pedro Christophersen, a Norwegian in business in Argentina, has agreed to finance Amundsen's expedition to the extent of $50,000.

Co-operation and Enthusiasm

Are evident in the manner in which our subscribers have responded to our request for the names of people whom the Scientific American should interest. We have received thousands of names and as a result we have had the pleasure of extending the subscriptions of a large number of our friends. Have you sent us a list? If not

Here is the way:

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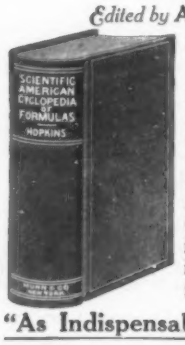

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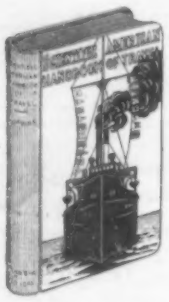

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